Private Equity and Corporate Borrowing Constraints: Evidence from Loan-Level Data*

Sharjil Haque† Young Soo Jang‡ Simon Mayer§

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Abstract

This paper demonstrates that private equity buyouts relax firms' financing constraints by enabling them to borrow against cash flows. Unlike comparable non PE-backed firms that primarily use asset-based debt, PE-backed firms rely extensively on cash flow-based debt subject to earnings-based borrowing constraints, and their borrowing and investments exhibit high sensitivity to earnings. Thus, private equity raises both the level and cash flow sensitivity of leverage. Documenting that PE sponsors inject equity and stabilize earnings in distress, we highlight how PE sponsors' involvement in distress resolution serves as a key mechanism that enables cash flow-based borrowing.

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†Board of Governors of the Federal Reserve System. Email: sharjil.m.haque@frb.gov
‡University of Chicago, Booth School of Business. E-mail: yjang0@chicagobooth.edu
§HEC Paris. E-mail: mayer@hec.fr

Recent studies highlight the importance of corporate borrowing constraints for firm policies, investment, and exposure to economic shocks (Chaney, Sraer, and Thesmar, 2012; Lian and Ma, 2021). However, since existing papers focus mostly on public firms, our understanding of the borrowing constraints of private firms and, notably, how they are affected by private equity (PE) buyouts remains limited. Indeed, PE sponsors often precipitate operational, financial, and capital structure changes in the firms they acquire, thus shaping the financing constraints of PE-backed firms. This paper shows that PE sponsors relax financing constraints by enabling PE-backed firms to borrow against future cash flows. As such, PE-backed firms rely extensively on *cash flow-based* debt based on the going-concern value of future cash flows and subject to earnings-based borrowing constraints. On the other hand, comparable non PE-backed firms primarily use *asset-based* debt based on the liquidation value of assets and subject to asset-based borrowing constraints.

According to our findings, leveraged private equity buyouts increase both the (i) level and (ii) cash flow sensitivity of leverage.[1] While the *level effect* (i) is well known (Kaplan and Stromberg, 2009; Axelson, Jenkinson, Strömberg, and Weisbach, 2013), this article establishes the novel *slope effect* (ii) by comparing PE-backed to matched non PE-backed firms with similar levels of debt, size, earnings, and tangible assets. Using administrative loan-level data from the Federal Reserve, we follow Lian and Ma (2021) and classify bank loans into asset-based (secured by a specific asset) and cash flow-based (unsecured or secured by blanket lien) debt. This classification allows us to analyze the debt structure and borrowing constraints of private firms, which crucially depend on the type of debt used for financing. We also highlight how borrowing constraints influence investment dynamics.

Controlling for the level of debt and determinants of the liquidation value of assets, we find that PE-backed firms have more cash flow-based debt and exhibit higher sensitivity of borrowing and investment to earnings than comparable non PE-backed firms. Due to their reliance on cash flow-based debt, PE-backed firms face earnings-based borrowing constraints which typically restrict total debt or interest expenses by a multiple of EBITDA. An increase in earnings relaxes such earnings-based borrowing constraints and so allows for additional borrowing and investment, making leverage and investment sensitive to earnings. In contrast, the borrowing constraints of non PE-backed firms tend to be asset-based and therefore less sensitive to earnings. Documenting that PE owners inject equity and stabilize earnings in distress, we highlight PE sponsors' involvement in distress resolution as a mechanism behind PE-backed firms' better access to cash flow-based borrowing.

Combining the Federal Reserve's Y-14 H.1 schedule (henceforth, Y-14 data) with Pitchbook, we construct a novel and large database of U.S. leveraged buyouts (LBOs). A unique

[1] In this paper, we focus exclusively on leveraged buyouts.

feature of our data is the detailed information on loan terms and collateral. Crucially for our analysis, this collateral information enables us to classify loans into asset-based and cash flow-based to shed light on private firms' debt structure and borrowing constraints.[2] The Y-14 data are collected as part of the Comprehensive Capital Analysis and Review (CCAR) process for bank holding companies and support Dodd-Frank Stress Tests, covering nearly 75 % of the total commercial and industrial (C&I) lending (Bidder, Krainer, and Shapiro, 2021; Favara, Ivanov, and Rezende, 2021). Our sample covers around 7,500 PE-backed, bank-reliant firms in the US, with approximately \$ 2.0 and \$ 0.9 trillion in annual book assets and book debt respectively. In the cross section, we capture nearly 15,000 unique loan facilities with committed credit of approximately \$ 773 billion at loan origination. To the best of our knowledge, this is one of the largest private equity buyout samples which covers small- and middle-market firms and includes detailed (time-varying) firm-level accounting and loan-level information.

We document that PE-backed firms tend to be larger and have higher levels of debt and leverage than non PE-backed firms. In particular, a private equity buyout increases a firm's leverage, both at the time of buyout and post-buyout. Importantly, the type of debt used for financing determines the anatomy of firms' borrowing constraints. With asset-based debt, borrowing is based on and constrained by the liquidation value of specific assets pledged as collateral (Kiyotaki and Moore, 1997). With cash flow-based debt, borrowing is based on and constrained by a measure of cash flows (i.e., EBITDA). Although cash flow-based debt is common among large public firms, small and middle-market firms in the U.S. primarily use asset-based debt (Lian and Ma, 2021). Notably, we show that this is not the case for small and middle-market PE-backed firms whose debt structure is similar to that of large and public firms. In particular, PE-backed firms (i) rely extensively on cash flow-based debt and (ii) exhibit a high sensitivity of borrowing and investments to changes in earnings.

Given that PE sponsors do not acquire target firms randomly, establishing a causal effect of PE ownership on debt structure is subject to endogeneity and selection issues. To mitigate these concerns, we match PE-backed and non PE-backed firms within the same industry and on observable (pre-buyout) firm characteristics such as earnings, size and tangible assets, which likely are important determinants of the liquidation value of assets, as well as leverage (i.e., the level of debt). Our matching follows Bernstein, Lerner, and Mezzanotti (2019), but with tangibility as an additional matching covariate given our research question. Our

[2] That is, we classify a loan as cash flow-based (asset-based) if it is secured by blanket lien or unsecured (if it is secured by a specific assets, such as, real estate, fixed asset, cash or accounts receivable). Intuitively, asset-based debt is backed by a specific asset as collateral, which creditors can seize in case of default; cash flow-based debt is not backed by any specific asset, and creditors have a claim on the entire firm value (minus assets pledged as collateral in asset-based lending) in case of default.

baseline regressions include firm, industry×year, and bank×year fixed effects, and various firm-level controls, such as the level of debt and total and tangible assets. Thus, they compare the same bank's credit commitments (e.g., in the form of term loans or credit lines) to PE-backed and observably similar non PE-backed firms.

According to our matched difference-in-difference estimates, PE ownership is associated with a higher sensitivity of borrowing and investments to changes in earnings. That is, private equity not only raises the level, but also the cash flow or earnings sensitivity of debt - the *slope effect*. Given that the maximum amount of cash flow-based debt is determined by earnings-based borrowing constraints, an increase in earnings relaxes such constraints, allowing firms to borrow and invest more. Crucially, since we can observe cash-flow based debt in the data, we also provide more direct evidence. We do so by aggregating all outstanding cash-flow based loans for a given firm-year and test if PE-sponsorship is associated with higher cash-flow based debt as a share of the firm's assets. Using the same matching and including similar controls and fixed effects as in our baseline regression, we show that this is indeed the case: PE ownership is associated with higher total cash flow-based debt at the firm level.

Why do PE-backed firms use more cash flow-based debt than non PE-backed firms? We provide evidence that non PE-backed firms' reliance on asset-based borrowing likely is a consequence of limited access to cash flow-based debt (at favorable terms). On the contrary, PE-backed firms use more cash flow-based debt because of better access to it. This lends support to a *supply-side* explanation behind our findings, although we cannot fully rule out a *demand-side* explanation. As a result, our findings suggest that private equity buyouts improve access to and therefore increases the use of cash flow-based debt.

In particular, we exploit the onset of the Covid-19 pandemic as an exogenous, negative, and aggregate shock to firms' earnings, which should tighten borrowing constraints and curb access to cash flow-based debt financing. To compare firms with similar pre-shock debt structure and borrowing constraints, we match PE-backed and non PE-backed firms on their pre-shock reliance on cash flow-based debt. Given this matching procedure, we expect matched PE- and non PE-backed firms to target similar levels of cash flow-based debt outside of distress situations when borrowing constraints are relaxed. Any post-shock differences in the use of cash flow-based debt between matched PE- and non PE-backed firms therefore should reflect post-shock differences in access to cash flow-based debt financing.

We then estimate the effect of PE ownership on the probability that following the Covid-19 shock, a loan from a given bank to a given firm is cash flow-based rather than asset-based. Doing so, we include several fixed effects (e.g., firm or bank- and industry-time fixed effects), loan controls (e.g., maturity, credit spread, or loan risk rating), and firm controls (e.g., EBITDA). As such, we compare observably similar loans by the same bank to borrowers in the same industry-quarter, which likely differ only by whether the borrower is PE-backed. We find that PE ownership is associated with a significantly higher likelihood of continued use of cash flow-based debt post-shock.[3] This suggests that the negative earnings shock curbs non PE-backed firms' access to cash flow-based debt to the extent that they use asset-based debt and pledge specific assets as collateral to borrow. On the contrary, PE-backed firms have continued access to cash flow-based debt following the earnings shock, corroborating that private equity improves access to cash flow-based borrowing.

Our finding that PE-backed firms can finance with cash flow-based debt even in distress situations highlights how PE sponsors' involvement in distress resolution serves as a key mechanism that enables cash flow-based borrowing. Intuitively, we expect that PE sponsors' involvement in distress resolution helps to preserve the going-concern value of the firm and its cash flows, thus facilitating cash flow-based borrowing. How do PE sponsors engage in distress resolution? We provide empirical evidence for two channels: (i) operational engineering and (ii) equity injections. First, PE sponsors engage in operational engineering to improve and stabilize earnings in distress (Gompers, Kaplan, and Mukharlyamov, 2022; Gryglewicz and Mayer, 2022). Consistent with the *operational engineering* channel, we show that PE ownership is associated with a lower decline in earnings after the Covid-19 shock. Second, PE owners often provide liquidity support to their portfolio companies by injecting equity in financial distress (Bernstein et al., 2019; Hotchkiss, Smith, and Strömberg, 2021).[4] Indeed, we find that, following the Covid-19 shock, PE-backed firms are more likely to receive equity injections than comparable non-PE-backed firms, especially when restricting the sample to smaller firms. Interestingly, our results suggest that the *equity injection* channel is most relevant for smaller firms.

Interestingly, we find that PE sponsors with higher reputation, measured using a sponsor's volume of past deals, are more effective at relaxing financing constraints and enabling cash flow-based borrowing. Following a negative earnings shock, firms backed by a high-reputation PE sponsor are significantly more likely to use cash flow-debt financing than similar PE- or non PE-backed firms. The interpretation is that high-reputation sponsors are more skilled in resolving distress or have superior access to dry powder to inject when necessary.

[3] One might be concerned that government support programs, such as the Federal Reserve's primary and secondary market corporate credit facilities, may have dampened the earnings shock resulting from Covid-19. This would only be a problem if the selection criterion of government support programs are systematically correlated with ex-ante characteristics of buyout targets; we discuss subsequently why this is unlikely.

[4] One potential reason for low prevalence of cash flow-based debt among small firms is that their financial distress has historically often been resolved through liquidation instead of restructuring which limits the pledgeability of future cash flows (Bernstein, Colonnelli, and Iverson, 2018).

We run several robustness tests to support our causal interpretation, such as re-estimating our baseline result with an alternate matching methodology. More notably, while our baseline results are obtained by analyzing firms' bank debt reported in the Y-14 data, we obtain similar conclusions when analyzing total or non-bank debt. Compared to matched non PE-backed firms, PE-backed firms exhibit significantly higher sensitivity of *total* debt to changes in earnings. Next, although the Y-14 covers a vast majority of corporate loans in the U.S., one concern could be that our sample lacks PE-backed firms that mostly borrow from non-bank lenders and private debt funds (Block, Jang, Kaplan, and Schulze, 2022). Using a dataset on non-bank lenders from Jang (2022), we show that such PE-backed firms, which mainly borrow from non-bank lenders, also exhibit high sensitivity of debt and investment to changes in earnings. These results underscore the external validity and robustness of our findings. PE-backed firms rely extensively on cash flow-based debt from banks or non-banks, making their borrowing sensitive to earnings.

Literature. First, our paper contributes to the literature on corporate debt structure and borrowing constraints. Lian and Ma (2021) document that large public companies rely on cash flow-based debt, while small companies mainly rely on asset-based debt (Gupta, Sapriza, and Yankov, 2022). Cloyne, Ferreira, Froemel, and Surico (2023) show that older firms use more cash flow-based debt than younger firms. Kermani and Ma (2022) study the relationship between firm liquidation values and debt contracts, and Kermani and Ma (2023) analyze asset specificity and liquidation values of non-financial firms. Hartman-Glaser, Mayer, and Milbradt (2023) present a dynamic contracting theory of endogenous asset- and cash flow-based financing, while Drechsel (2022), Drechsel and Kim (2022), and Ivashina, Laeven, and Moral-Benito (2022) highlight macroeconomic implications of asset- and cash flow-based borrowing. Differently from Lian and Ma (2021), Cloyne et al. (2023), and Kermani and Ma (2022) studying public firms, we employ a large data set of small and middle-market private firms to analyze how private equity buyouts shape firms' borrowing constraints and choice between cash flow and asset-based debt.

Second, we contribute to the large literature on the real effects of private equity buyouts. As suggested by Kaplan and Stromberg (2009), recent theories (Malenko and Malenko, 2015; Gryglewicz and Mayer, 2022), and survey evidence (Gompers et al., 2022), PE sponsors affect firm outcomes through operational, governance, and financial engineering and play an important role in relaxing financing constraints (Bernstein et al., 2019; Hotchkiss et al., 2021; Cohn, Hotchkiss, and Towery, 2022). In this context, several articles study whether and how PE owners affect firm outcomes, managerial incentives, stakeholders, and/or create value (see, among others, Boucly, Sraer, and Thesmar (2011); Cronqvist and Fahlenbrach (2013);

Bernstein and Sheen (2016); Antoni, Maug, and Obernberger (2019); Aldatmaz and Brown (2020); Bellon (2020); Gupta, Howell, Yannelis, and Gupta (2021); Gornall, Gredil, Howell, Liu, and Sockin (2021); Cassel (2021); Spaenjers and Steiner (2021); Fracassi, Previtero, and Sheen (2022)). We complement this literature by studying how private equity affects borrowing, borrowing constraints, and investment dynamics.[5]

Third, we add to existing work on the capital structure in private equity and LBOs. Axelson, Strömberg, and Weisbach (2009) show theoretically that the optimal financing arrangement of private equity buyouts involves high leverage. Axelson et al. (2013) study the determinants of buyout leverage at the time of buyout. Unlike Axelson et al. (2013), our data allow us to study post-buyout leverage dynamics. Cohn, Mills, and Towery (2014) show that buyouts lead to an increase in leverage. Demiroglu and James (2010), Ivashina and Kovner (2011), Achleitner, Braun, Hinterramskogler, and Tappeiner (2012), Shive and Forster (2021) and Badoer, Emin, and James (2021) study how PE sponsors and their reputation affect the terms of debt financing and covenant structure in LBOs. Haque and Kleymenova (2023) study loan renegotiation and contract enforcement in LBOs. A distinguishing feature of our paper is the detailed loan-level and collateral information contained in our data. This information allows us to classify loans into asset- and cash flow-based to obtain novel insights on the effects of private equity on borrowing constraints and debt structure.

1 Data and Sample Characterization

1.1 Data Source

We create a novel and large sample of PE-backed, bank-reliant, small and middle-market firms in the U.S. with detailed firm-year financial accounting data by merging two data sources: The Federal Reserve's Y-14 data, containing an extensive collection of commercial loans, and U.S. buyout deals from Pitchbook. We discuss both data sources in the following.

PE Buyout List from Pitchbook. We rely on Pitchbook's leveraged buyout list to identify sponsored deals. Pitchbook is widely regarded as one of the most comprehensive PE databases and is especially strong for the U.S. data and the most recent decade (Gornall et al., 2021). This is particularly advantageous for us, given that the Y-14 sample, described

[5]See Chaney et al. (2012) and Catherine, Chaney, Huang, Sraer, and Thesmar (2022) for evidence on how borrowing constraints matter for investment and firm outcomes. Note that Chaney et al. (2012) and Catherine et al. (2022) focus on collateral-based borrowing constraints, the prevalent borrowing constraint for asset-based debt, whereas we distinguish between asset-based and cash flow-based debt that typically features earnings-based borrowing constraint.

below, starts in 2012. Pitchbook's buyout data contain identifying information on sponsored portfolio companies, the name of the sponsor, and crucially deal closing dates, allowing us to distinguish between pre- and post-PE ownership samples. If a company is acquired twice or more in our sample by a PE fund (secondary or tertiary buyout), we only use the earliest chronological buyout date.

The Federal Reserve's Y-14. Our analysis requires detailed financial statements data from PE-backed firms that are smaller than the typical Compustat firm (median assets approximately $ 1 billion). Our key data source is the Federal Reserve's FR Y-14Q H.1 collection for commercial loans (in short, the Y-14 data).[6] The Y-14 data consist of information on all loan facilities with over $ 1 million in committed amount held by Bank Holding Companies (BHCs), and began in June 2012 to support the Dodd-Frank Stress Tests and the Comprehensive Capital Analysis and Review. The key advantage of the Y-14 data is the extensive coverage of small and middle-market private firms that borrow from the largest U.S. banks. This gives us a rich view into loan terms, including information such as the asset securing a given loan facility. Prior studies have documented that the firms in the Y-14 data account for more than 60 percent of the total U.S. corporate debt and almost 80 percent of the U.S. gross output (Caglio, Darst, and Kalemli-Özcan, 2021). Our data cleaning procedure is described in detail in Appendix B.

Our analysis exploits both the annual balance sheet information of private firms and the relatively more granular loan-level data. The firm-level balance sheet data is reported annually, while loan-level data are reported quarterly. For the firm-bank level analysis, we collapse the loan-level data into a bank-firm-year panel by aggregating all outstanding credit facilities between a bank and a borrower in a given year. We distinguish between loans that are backed by physical assets (real estate, cash, accounts receivable or inventory) from loans that are either secured by a blanket lien or unsecured. Following Lian and Ma (2021), we define loans that are backed by physical assets (real estate, cash, accounts receivable, or inventory) as *asset-based* and loans that are secured by a blanket lien or unsecured as *cash flow-based*. That is, cash flow-based debt corresponds to borrowing against (future) cash flow and asset-based debt corresponds to borrowing against the liquidation value of assets.

We merge information on PE-backed firms from Pitchbook with their financial information in the Y-14 data using a string matching algorithm outlined in Cohen, Dice, Friedrichs, Gupta, Hayes, Kitschelt, Lee, Marsh, Mislang, Shaton, et al. (2021), and then manually ver-

[6] For details on every variable contained in schedule H.1. and how banks are required to report information to the Federal Reserve, see the Table beginning in page 170 in the publicly available reporting form. It can by retrieved by simply searching for 'FR Y-14Q Instructions DFAST 2021 Draft.pdf'

ify the accuracy of our match.[7] To produce a relatively balanced firm-year panel, we restrict the sample to 2013-2021. We are able to match 7,506 unique PE-backed firms. This merge leads to an unbalanced panel of over 34,700 firm-year observations for which we can see book assets, tangible assets, accounts receivables, inventory, total debt, cash and marketable securities, EBITDA, and several other balance sheet variables. The coverage of the post-buyout and pre-buyout samples is reasonably similar. Similar to prior studies, our benchmark analysis will exploit information from both the pre-(post-) buyout samples. Figure A2 aggregates book assets and book debt in each calendar year over PE-backed firms. On average, we are able to capture around $ 2.0 trillion in book assets in a typical year.[8]

Lian and Ma (2021) define large firms as those above the Compustat median: firms with book assets greater than $ 1 billion. Consistent with their definition, we first classify small firms as those with book assets below $ 1 billion, which is more than 80 percent of all Y-14 firms. Furthermore, our key results remain qualitatively and quantitatively similar under an alternative definition of small firms, i.e., firms with book assets below $ 500 million.

1.2 Descriptive Statistics: Facts on PE-backed Firms in Y-14 Data

To the best of our knowledge, our database is one of the largest U.S. buyout samples that includes detailed firm-year financial accounting data, as well as time-varying loan-level information. As such, we can contribute to the literature by providing a large sample descriptive analysis of PE-backed firms in the U.S. over time. Table 1 reports the accounting and financial characteristics of PE-sponsored firms that borrow from U.S. banks; in what follows, we use the terms PE-backed, PE-sponsored, and PE-owned interchangeably. All variables are defined in Appendix A.

Panel A reports the full PE sample covering more than 7,500 unique PE-backed firms, while Panel B is restricted to non-PE firms. In this Section, we categorize small firms as those with book assets less than $ 500 million.[9] Table 2a presents descriptive statistics of our loan-level variables, again split between PE and non-PE. We present several key facts on PE-backed small and middle-market firms contained in Y-14.

[7]For company-level matching, the algorithm uses a two-stage matching method that pairs traditional string matching techniques with probabilistic record linkage methods. We refer the interested readers to Cohen et al. (2021) for further details. An example of the R package for the company-level match can be found on Github at: https://github.com/seunglee98/fedmatch

[8]The drop in value in 2021 is due to lower coverage at the time the data was retrieved.

[9]As mentioned earlier, in our main analysis, we offer two alternative definitions of small firms based on book assets: those with book assets of less than $ 0.5 billion and those with $ 1 billion. In particular, we show that our key findings are qualitatively and quantitatively similar under either definition of small firms.

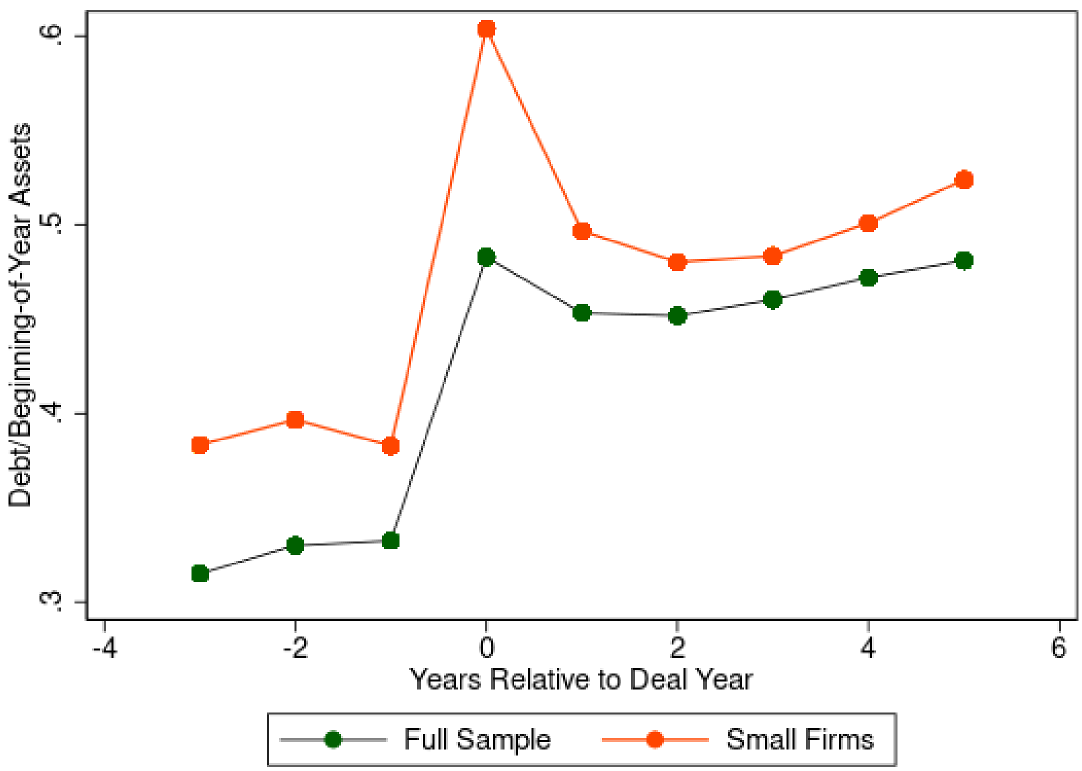
Table 1: Firm-level Descriptive Statistics

Panel A: PE	N	Mean	SD	p25	p50	p75
Total Assets	34,757	1,130	3,190	20.2	115	690
Sales/Assets	34,757	2.17	2.87	0.8	1.47	2.6
Tangibility	34,757	73.4	28.2	50.6	54.3	99.6
Receivables	34,757	19.4	17.8	6.5	14.4	26.9
Inventory	34,757	14.2	18.3	0	6.7	22.4
Cash	34,757	8.2	11.9	1.1	3.7	9.9
EBITDA	34,757	15.8	101	6.9	12	20.8
Total Liabilities	34,757	69.8	39.5	50.8	65.9	81.6
Total Debt	34,757	45.1	35.8	19.3	38.9	60.9
Short-term Debt/Debt	33,210	20.2	33.5	0	0	27.3

Panel B: Non-PE	N	Mean	SD	p25	p50	p75
Total Assets	461,680	800	339	7.6	21.2	97.7
Sales/Assets	461,680	2.8	3.6	1.15	2.16	3.4
Tangibility	461,680	89.3	19	88.2	98.9	100
Receivables	461,680	18.9	19.7	3.6	12.6	28
Inventory	461,680	21.5	24.7	0	10.9	38.5
Cash	461,680	10.7	13.6	1.5	5.8	14.6
EBITDA	461,680	18.4	93.6	5.3	11.7	21
Total Liabilities	461,680	67.5	256	48.4	64.7	80.3
Total Debt	461,680	43.5	35.6	16.7	35.7	16.3
Short-term Debt/Debt	461,680	35.1	40.2	0	10.8	100

(a) *Notes: This table presents descriptive statistics of our firm-level sample of PE-backed firms in percentages of book assets (except Total Assets, which is expressed in USD, and Sales/Assets, which is a ratio). Variable definitions and constructions are provided in the Appendix A. Panel B presents the same statistics for non-PE firms. Sample period is 2013-2021. Panel A includes 7,506 unique PE-backed firms. Note the PE sample includes both pre and post buyout information. See Appendix Table A3 for descriptive statistics for the full sample post-buyout.*

Figure 1: Leverage in Firms Sponsored by Private Equity Funds



(a) *Notes: This chart plots the median ratio of Debt to beginning-of-period total assets. The x-axis depicts years relative to a PE buyout, where 0 is the year of the buyout. Total debt is the sum of short-term and long-term book debt. Total sample comprises 7,506 unique PE-backed firms. Small firms consist of 6,301 unique PE-backed firms.*

Fact 1: PE-backed firms are larger. Previous studies using Y-14 data report that the median (not necessarily PE-backed) Y-14 firm has book assets of about $ 20 million (Brown, Gustafson, and Ivanov, 2021; Gupta et al., 2022). On the contrary, the median PE-backed firm in our sample is much larger and has book assets of $ 115 million, while more than 75 percent of PE-backed firms have book assets greater than $ 20 million. As Table 1 shows, median non-PE sample has books assets of around USD 21 million: roughly one-sixth the size of the typical PE firm.

Fact 2: Leverage increases at the time of buyout and stays elevated post-buyout. Figure 1 plots the (median) leverage ratio (debt/asset) in PE-sponsored firms in years relative to an LBO event for (i) the full sample and (ii) small firms (book assets < 500 million).[10] We observe a sharp increase in leverage in the year of buy-out, a pattern also documented in previous studies (Axelson et al., 2013; Cohn et al., 2014; Brown, 2021). Interestingly, this increase is more pronounced for small firms: Their leverage ratios rise sharply from around 40 percent to around 60 percent in the year of the buyout, come down somewhat post-buyout, but stay at a significantly higher level compared to pre-buyout in the following years.[11] The overall increase in leverage suggests a long-term change in capital structure following PE buyout, also found in Shive and Forster (2021). Finally, we also observe that PE-backed firms have less short-term debt (debt that matures within 1 year) relative to non-PE, as reported in Table 1.

Fact 3: PE-backed firms pay higher interest rate spreads. Our data also allow us to observe interest rates and spreads of individual loans. Interestingly, loans to PE-backed firms are on average more expensive, that is, they have higher spreads. This is not surprising, because PE-backed firms have higher leverage, which ceteris paribus implies higher credit risk. As can be seen in Table 2a, the median PE-sponsored loan pays 50 basis point additional spread relative to the universe of non-PE borrowers. At the 75th percentile, this difference is 100 basis points.

Fact 4: PE-backed firms have more cash flow-based debt. A unique feature of our data is that we observe the collateral backing a loan. Using this information, we follow Lian and Ma (2021) to classify a loan as *cash flow-based*, if it is backed by blanket lien or

[10] To ensure a relatively even distribution of observations for each year relative to a buyout, we restrict the chart to (three) five years (pre-) post-buyout.

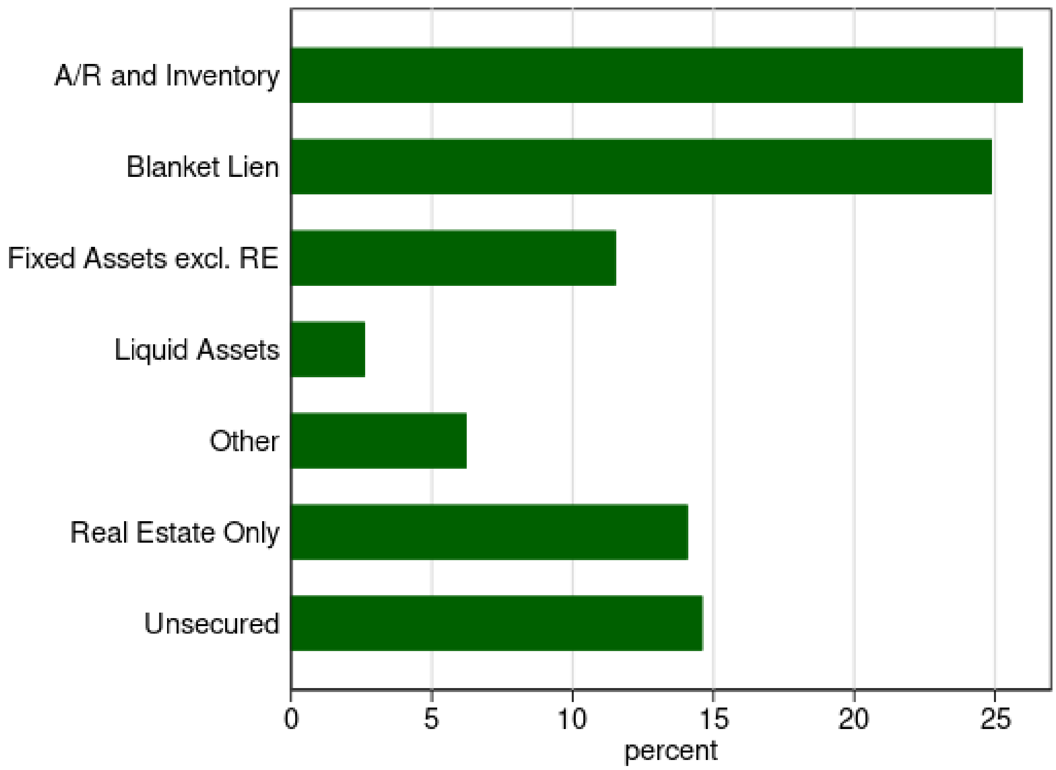
[11] Since we scale book debt with beginning-of-period total assets, the incremental value generated from new buyout debt likely begins to appear in the data in year $t = +1$ where $t = 0$ is the buyout year, thus leading to the moderate decline in leverage in the year following the deal.

Table 2: Descriptive Stats: Loan-level Data

Panel A: PE Sample	Mean	SD	p25	p50	p75
Committed Credit (Mn USD)	40.1	240	2.5	6.7	20
Utilization Rate (%)	55.2	42.5	2.4	60.9	100
Interest Rate (%)	3.4	2.7	1.8	3.6	4.9
Spread (%)	2.1	1.8	0	2	3.3
Spread (%) during Covid	2	1.7	0	2	3.3
Maturity (Years)	5.62	3.61	4	5	6
Commitment - Secured Debt	39.7	255	2.5	6.6	19.6
Commitment - Unsecured Debt	45.8	126	2	8	37.6
Panel B: Non-PE					
Committed Credit (Mn USD)	53.6	318	1.7	3.9	149
Utilization Rate (%)	59.4	42.9	4.2	77.1	100
Interest Rate (%)	2.7	2.1	1.4	2.8	4
Spread (%)	1.4	1.7	0	1.5	2.3
Spread (%) during Covid	1.4	1.4	0	1.4	2.2
Maturity (Years)	7	9.3	4	5	9
Commitment - Secured Debt	55.6	344	1.6	3.3	10.5
Commitment - Unsecured Debt	42.3	80.9	2.9	15	51.1

(a) *Notes: This table presents descriptive statistics of our loan-level sample of PE-backed firms and non-PE firms. Note that in this particular table, non-PE firms are not matched to PE, and represents the entire distribution of borrowers from Y-14 firms that never feature a PE sponsor. Variable definitions and constructions are provided in the Appendix A. Total PE sample includes around 75,000 observations, and the non-PE sample is the entire database on obligors in the Y-14 database capturing over 3 million loan-time level observations.*

Figure 2: Loan Collateral



(a) *This figure plots the share of loans backed by type of collateral. The sample ranges from 2013 to 2021 and includes 4.88 million loan-time observations. A loan facility can be observed in multiple periods. However, there may be variations in the collateral pledged to back the credit facility during the life of the loan, depending on loan terms, firm, bank, or external conditions. "A/R" and "RE" denote accounts receivable and real estate, respectively. In total, the share of cash flow-based loans, which are unsecured loans or loans backed by blanket lien, is about 40 percent.*

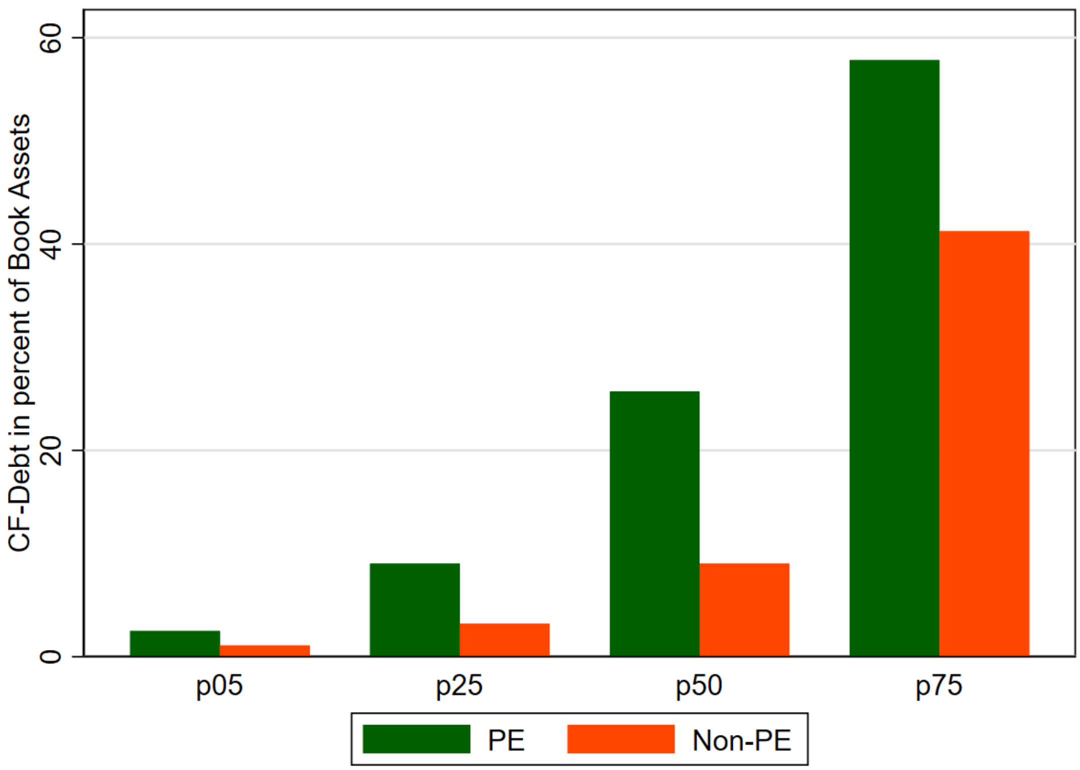
unsecured, and as *asset-based* if it is backed by a specific asset (e.g., real estate, fixed asset, cash or accounts receivable). Intuitively, asset-based debt is backed by a specific asset as collateral which creditors can seize in case of default; cash flow-based debt is not backed by any specific asset, and creditors have a claim on the entire firm value (minus assets pledged as collateral in asset-based lending) in case of default. As argued by Lian and Ma (2021) or Drechsel (2022), the type of debt financing used (e.g., cash flow- vs. asset-based) affects firms' borrowing constraints and outcomes. Figure 2 shows that around 60 percent of loans in the entire Y-14 sample are asset-based, while the remaining 40 percent are cash flow-based. In Figure 3, we aggregate all cash flow-based debt by PE-backed firms and *matched* non PE-backed firms and examine the full distribution of cash flow-based debt (relative to firm size measured by book assets) across the two firm types; the details on the matching procedure are outlined in Section 2.2. Note that PE-backed firms have more cash flow-based debt than comparable non PE-backed firms. Existing empirical evidence reveals that cash flow-based debt is very common among large public companies, but not among small companies that use asset-based debt (Lian and Ma, 2021). However, our findings suggest that this is not the case for small and middle-market PE-backed firms whose debt structure is similar to that of large and public firms. Related, we show in Section 4.2 that, as documented in Lian and Ma (2021) for large public companies, the borrowing of PE-backed companies is highly sensitive to changes in earnings.

2 Empirical Analysis

In this Section, we present our main empirical analysis, yielding the following key results. First, PE ownership is associated with an increased sensitivity of borrowing and investment to changes in earnings. Second, PE-backed firms have more cash flow-based debt than matched non PE-backed firms with similar levels of total debt. Third, PE-backed firms have better access to cash flow-based debt financing, especially so in distress situations, which explains why PE-backed firms use more cash flow-based debt financing.

Crucially, the first result arises from a regression analysis at the firm-bank-year level. Our granular data allow us to employ this very tight specification, where we fix a bank and track its commitments to two observably similar firms that differ primarily by PE-backing. In this way, we are able to isolate our results from bank-specific channels. The second result is obtained at the firm-year level. Taken together, these results imply that due to their use of cash flow-based debt, PE-backed firms face earnings- or cash flow-based borrowing constraints. Typically, earnings-based borrowing constraints stipulate that a firm's total debt or interest expenses cannot exceed a multiple of EBITDA. Such constraints are relaxed (tight-

Figure 3: Distribution of Cash Flow-Based Bank Debt



(a) *Notes: This chart plots the distribution of cash flow-based bank debt in percent of beginning-of-period total assets both for PE-backed and non PE-backed firms. See Appendix A for the definition of CF-based debt. For PE-backed firms, we retain only the post-buyout sample. For a given year, we construct the ratio by collapsing all unique cash flow-based loans for a particular borrower and then scale by book assets. Non PE-backed firms refer to the matched sample constructed using the matching procedure outlined in Section 2.2. Note that this chart may understate total cash flow-based debt since we do not observe non-bank debt structure.*

ened) upon an increase (decrease) in earnings, making borrowing and borrowing capacity sensitive to changes in earnings. We also show that PE-backed firms' capital expenditures and investments are highly sensitive to earnings.

For the third result, we exploit that our data contain individual loan data to perform a regression analysis at the loan-quarter level. We take Covid-19 as an exogenous negative shock to firms' earnings, which should reduce the availability of cash flow-based debt financing for firms. As we show, immediately following Covid-19 shock, PE-backed firms continue to finance with cash flow-based borrowing, while comparable non PE-backed firms are more likely to switch to asset-based debt and pledge specific collateral to borrow. This suggests that PE sponsors improve their portfolio firms' access to cash flow-based debt.

2.1 Matched Firm Sample

An important challenge in estimating the causal effects of PE ownership on debt structure is that PE owners do not target firms at random. To address nonrandom selection, we use for our main analysis a matched sample of PE- and non PE-backed firms. The control group (non PE-backed firms) is constructed to match PE-backed firms on observable characteristics. Specifically, for all PE-backed companies in our data, we select at most 5 non PE-backed companies in the Y-14 sample in the *pre-deal year* that (i) belong to the same two-digit NAICS code and have (ii) EBITDA, (iii) book assets, (iv) leverage ratio, and (v) share of tangible assets within a 20 percent bracket around the characteristics' corresponding value for the PE-backed firm. These variables are chosen to match the determinants of the debt structure as well as the leverage itself. We also match on key determinants of the liquidation value of firm assets, such as book assets, industry, and tangibility.

Our matching methodology is similar to Bernstein et al. (2019), except that we match to a tighter bracket and on an additional variable (that is, the share of tangible assets). We match on tangibility, as it likely determines liquidation value of assets, and thus firms' choice between asset- and cash flow-based debt. Table A1 in the Appendix shows that our matching procedure leads to a control sample that is reasonably comparable to our (treatment) sample of PE-backed firms in terms of all the matching covariates as well as covariates we did not match on (e.g., liquidity and sales/assets).[12]

Finally, when presenting our key results, we focus on small (and middle-market) firms

[12] Additionally, we also see the distribution across treated firms and controls is similar. For example, the standard deviation of firm size, tangible assets, liquidity, debt/asset are similar for control and treatment group; the control group has somewhat lower standard deviation in EBITDA. In our robustness tests, to be discussed subsequently in Section 4, we discuss an alternative matching procedure where we match on liquidity in addition to size, tangibility, earnings and debt. This results in a slightly lower quality of the matched control group, particularly in terms of EBITDA, but does not change our main results.

with book assets below \$ 1 billion and \$ 500 million respectively. We do so mainly for the following reasons. First, the effect of PE ownership on debt structure is particularly relevant for small companies, because these companies tend to have limited access to cash flow-based debt financing (Lian and Ma, 2021). Second, as large firms use cash flow-based debt financing also in the absence of PE sponsors, the focus on smaller firms allows us to more clearly identify the effects of PE ownership on debt structure. Third, more than 80 % of Y-14 firms have book assets below \$ 1 billion; thus, restricting our sample to small firms, we study the typical and average Y-14 firms. We also verify that our key results hold for the full sample of Y-14 firms, underscoring the robustness of our findings.

2.2 Private Equity and Cash Flow sensitivity of Debt

Following Lian and Ma (2021), we examine the sensitivity of borrowing to (changes in) earnings. High sensitivity of borrowing to earnings suggests the presence of earnings-based borrowing constraints, and, because earnings-based borrowing constraints are common in cash flow-based debt, is indirect evidence for the use of cash flow-based debt. We depart from Lian and Ma (2021) in two dimensions. First, our granular data allow us to employ a tighter specification at the firm-bank-year level rather than the firm-level. Second, we examine the effect of PE ownership on the sensitivity of borrowing to earnings. That is, estimate the following regression with data aggregated at the bank-firm-year level:

$$y_{i,b,t} = \beta_1 EBITDA_{i,t} \times PE_{i,t} + \beta_2 PE_{i,t} + \beta_3 EBITDA_{i,t} + \gamma X'_{i,t-1} + FEs + \epsilon_{i,b,t}, \quad (1)$$

where $y_{i,b,t}$ is the outcome variable of interest in the lending relationship between bank b and firm i in year t. Our main outcome variable is $y_{i,b,t} := \Delta L_{i,b,t}$, which is the *change* in bank credit commitment of firm i borrowing from bank b in year t (scaled by beginning-of-period total assets of firm i). Bank credit commitments can be in the form of term loans, revolving credit lines, or any other type of loan. As in Lian and Ma (2021), our outcome variable is a flow that measures the change in bank debt; note that EBITDA as an independent variable is also a flow variable. $PE_{i,t}$ is an indicator capturing whether a firm is PE-backed in year t. The key variable of interest is $PE_{i,t} \times EBITDA_{i,t}$ which captures the marginal effect of PE-ownership on the sensitivity of the outcome variable following a change in earnings.

We include a series of one-year lagged firm-level controls ($X_{i,t-1}$): Share of tangible assets, capital expenditures, accounts receivables, EBITDA, leverage (debt/book assets), and the logarithm of book assets. Thus, we compare firms with similar levels of debt and asset liquidation, as we control for important determinants of asset liquidation value. Furthermore, we include firm fixed effects, industry×year fixed effects to capture time-varying demand

Table 3: Benchmark Estimates: Changes in Bank Credit Commitments

$\Delta L_{i,b,t}$	*Assets* < \$ 1 *Bn*		*Assets* < \$ 0.5 *Bn*	
	(1)	(2)	(3)	(4)
$PE \times EBITDA$	0.019***	0.019***	0.020***	0.021***
	(0.006)	(0.006)	(0.007)	(0.007)
$EBITDA$	0.003	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
R-squared	0.361	0.368	0.368	0.375
Firm Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Bank×Year FE	Y	Y	Y	Y
Industry×Year	N	Y	N	Y
N	30,594	30,589	25,392	25,386

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports regression estimates of bank debt issuance on an interaction between PE-ownership and firm earnings proxied by EBITDA over beginning-of-period total assets.* $PE_{i,t}$ *takes value 1 for when firm i is PE-backed in year t. The matched control group is constructed as outlined in Section 2.2. The dependent variable* Δ $L_{i,b,t}$ *is the change in committed bank credit from bank b to firm i, scaled by beginning-of-period total assets of firm i. In the first two columns, we define small firms as those with book assets less than \$ 1 billion, and in the last two columns as those with book assets less than \$ 0.5 billion. All regressions include the following time-varying controls: share of tangible assets, capital expenditures, accounts receivables, EBITDA, leverage (debt/book assets) and the natural logarithm of book assets. Sector FE is defined as the 2-digit NAICS-code. Standard errors are clustered at the borrower level.*

shocks specific to each industry and common across all banks lending to firms in the same industry, and bank×year fixed effects to capture unobserved time-varying shocks to bank balance sheets and capital adequacy ratios and heterogeneity across lenders. Our fixed effects also control for aggregate credit conditions, which are an important determinant of buyout leverage (Axelson et al., 2013). Accordingly, the coefficient of interest β_1 is identified by comparing changes in committed credit by the same bank to PE-backed and matched non PE-backed firms within the same industry×year, following a change in the borrower's earnings. We cluster standard errors at the firm level.

Table 3 reports the results of the regression estimation. Columns (1) and (2) illustrate that an increase in EBITDA is associated with around 2 percent additional increase in $\Delta L_{i,b,t}$ if a firm is PE-backed relative to a matched non PE-backed firm. Thus, PE ownership is associated with significantly higher sensitivity of bank credit to changes in earnings. Moreover, the individual effect of EBITDA is small and generally not significant, suggesting that the sensitivity of borrowing to earnings is low or negligible for matched non PE-backed firms and small firms in general. This is consistent with previous empirical evidence that private firms' borrowing is mainly based on the liquidation value of assets and thus is not sensitive to earnings (Lian and Ma, 2021).

Finally, for robustness, Table A4 in the Appendix presents the regression results for the full sample. It shows that also for the full sample, the coefficient β_1 remains positive and statistically significant. Furthermore, Section 4.1 shows that our conclusions are not restricted to bank debt. In fact, we show that private equity also increases the sensitivity of *total* debt to earnings.

2.3 Private Equity and Cash Flow-Based Debt

PE-backed firms' borrowing is highly sensitive to changes in earnings, which is indirect evidence for the use of cash flow-based debt financing and the presence of earnings-based borrowing constraints. We now provide direct evidence that PE-backed firms have more cash flow-based debt than matched non PE-backed firm with similar levels of total debt. For each firm, we directly aggregate all outstanding cash flow based bank debt in a given year (in dollars) scaled by the firm's total book assets, that is, $CFDebt_{i,t}$. This quantity captures firm i's use of cash flow-based debt financing in a given year t. We then run the following regression at the firm-time level:

$$CFDebt_{i,t} = \beta PE_{i,t} + X_{i,t} + \alpha_i + \eta_t + \epsilon_{it}. \tag{2}$$

As in the regression (1), we include various firm control variables (i.e., share of tangible assets, capital expenditures, accounts receivables, EBITDA, leverage (debt/book assets), and the natural log of book assets) as well as firm fixed effects. We also alternate between year fixed and sector-year fixed effects within the two size buckets of USD 1 Bn and USD 500 Mn.

Table 4 provides direct and robust evidence that PE-backed firms rely extensively on cash flow-based debt financing, while non PE-backed firms primarily finance with asset-based debt. In all of our specifications, the coefficient $\beta > 0$ is positive and significant. The estimates range from 0.277 to 0.375. Thus, relative to matched non PE-backed firms, PE-backed firms use more cash flow-based debt. As cash flow-based debt typically comes with earnings-based borrowing constraints, PE-backed firms' reliance on cash flow-based debt makes their borrowing sensitive to changes in earnings, as documented in Table 3.

Table 4: Cash Flow Based Debt and PE: Direct Evidence

	$Assets < \$1\ Bn$		$Assets < \$0.5\ Bn$	
	(1)	(2)	(3)	(4)
$PE_{i,t}$	0.277***	0.296**	0.336***	0.375***
	(0.105)	(0.117)	(0.123)	(0.140)
R-squared	0.540	0.543	0.540	0.544
Firm FE	Y	Y	Y	Y
Year FE	Y	N	Y	N
SectorxYear	N	Y	N	Y
N	19,511	19,494	17,145	17,128

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table plots regression estimates of of* $PE_{i,t}$ *on firm-level aggregated cash-flow based debt. The dependant variable is the aggregated yearly cash-flow based debt computed directly using data on underlying collateral information. Cash Flow based debt are those backed by a blanket lien or is unsecured. Because the regressions are at the borrower/firm-level and not firm-bank level, we do not include bank-time fixed effects. Standard errors are clustered at the borrower level.*

2.4 Private Equity and Investment-Earnings Sensitivity

We now show that because PE-backed firms use cash flow-based debt, their investment and capital expenditures become highly sensitive to changes in earnings. The intuition is that with cash flow-based debt, an increase in earnings relaxes borrowing constraints and allows the firm to borrow and invest more. To examine the effect of private equity on investment and its sensitivity to earnings, we run the following firm-level regression:

$$y_{i,t} = \beta_1 EBITDA_{i,t} \times PE_{i,t} + \beta_2 PE_{i,t} + \beta_3 EBITDA_{i,t} + \gamma X^{'}_{i,t-1} + FEs + \epsilon_{i,t}. \quad (3)$$

The choice of control variables and fixed effects follows our baseline regression (1). Table 5 reports the regression results of (3) with firm-level capital expenditures in year t, that is, $y_{i,t} = Capex_{i,t}$, as the outcome variable. Indeed, capital expenditures of PE-backed firms are significantly more sensitive to changes in earnings than to those of matched non PE-backed firms. The effects are also economically significant. A one unit increase in EBITDA is associated with around 2-3 percent increase in capital expenditure (scaled by beginning-of-year assets).

This result highlights that by shaping firms' debt structure and borrowing constraints, PE owners also influence firm policies and real outcomes, and their exposure to (aggregate) shocks. Because PE-backed companies rely extensively on cash flow-based debt to finance investments, their investment is sensitive to earnings shocks, but less so to asset price shocks that affect asset-based borrowing constraints (Chaney et al., 2012). Conversely, non PE-

Table 5: Matched Diff-in-Diff Estimates: Capital Expenditures

$y_{i,t}$: $Capex_{i,t}$	*Assets* < $ 1 *Bn*		*Assets* < $ 0.5 *Bn*	
	(1)	(2)	(3)	(4)
$PE \times EBITDA$	0.025*	0.029**	0.023*	0.027*
	(0.013)	(0.014)	(0.013)	(0.014)
$EBITDA$	0.011**	0.012**	0.009*	0.006
	(0.005)	(0.006)	(0.005)	(0.005)
R-squared	0.442	0.522	0.478	0.544
Firm Controls & FE	Y	Y	Y	Y
Bank×Year FE	Y	Y	Y	Y
Sector×Year	N	Y	N	Y
N	31249	31230	26070	26051

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *This table reports estimates of various outcome variables on an interaction between PE-ownership and firm earnings proxied by EBITDA/beginning of year book assets. The outcome variable is capital expenditures scaled by lagged assets, respectively. The matched control group is constructed as described in Section 2.2. In the first two columns, we define small companies as those with book assets less than $ 1 billion, and in the last two columns as those with book assets less than $ 0.5 billion. Firm controls are the same as reported in Table 3, except that we naturally exclude* capex *as a control. Sector FE is defined as the 2-digit NAICS-code. Standard errors are clustered at the borrower level.*

backed firms use more asset-based debt, and so are more exposed to shocks to asset prices.

Showing that private equity buyouts and the associated reliance on cash flow-based debt financing raise the sensitivity of borrowing and investment to earnings, we add to the literature on investment-earnings or investment-cash flow sensitivity and financing constraints pioneered by Fazzari, Hubbard, and Petersen (1988). As argued by Kaplan and Zingales (1997, 2000), the investment-cash flow sensitivity does not accurately measure financing constraints. Instead, as shown by Almeida, Campello, and Weisbach (2004), the cash flow sensitivity of cash captures firms' financial constraints.[13]

2.5 Earnings Shock and Distress

Why do PE-backed firms use more cash flow-based debt? Do non PE-backed firms rely on asset-based debt, because they prefer to do so even in the absence of constraints (demand-side explanation) or because they are constrained and have limited access to cash flow-based debt (supply-side explanation)? We now provide evidence that PE-backed firms use more cash flow-based debt because they have better access to it, and especially so in distress situations.

[13]Note that since cash is not "negative debt" (Acharya, Almeida, and Campello, 2007), the cash flow sensitivity of cash and debt need not be closely related.

On the other hand, non PE-backed firms' access to cash flow-based debt (at favorable terms) is limited, so they are effectively constrained to asset-based borrowing. That is, our results lend support to a supply-side explanation, although we cannot fully rule out a demand-side explanation. Specifically, our findings below suggest that PE sponsors' involvement in distress resolution increases PE-backed firms' access to and use of cash flow-based debt.

To examine firms' access to cash flow-based debt in distress situations, we exploit the onset of the Covid-19 pandemic in the beginning of 2020 as an exogenous, negative and aggregate shock to earnings. Notice that Covid-19 not only represented a negative (aggregate) shock to firm earnings, but also introduced a large uncertainty around its persistence (Gormsen and Koijen, 2020), both of which should limit access to and availability of cash flow-based debt financing. To minimize confounding effects, we study a sample where the pre-shock period is 2019:Q1-Q4 and the post-shock period is 2020:Q1-Q3. In robustness tests, we show that choosing different pre- (post-) shock periods does not affect our results.[14]

In our analysis, we compare PE- and non PE-backed firms with similar reliance on cash flow-based debt financing (i.e., similar borrowing constraints) prior to Covid-19. That is, we match PE-backed and non PE-backed firms based on their pre-shock use of cash flow-based debt. Non PE-backed firms are selected such that they had any cash flow-based debt outstanding in the calendar year preceding Covid-19.[15] Thus, absent large shocks to earnings, i.e., outside of distress, matched PE- and non PE-backed firms should have similar (optimal) debt structure, cash flow-based debt, and borrowing constraints. As we also include various loan, bank, and firm level controls and fixed effects into our regressions, any change in debt structure post-shock therefore can be attributed to the negative earnings shock. Any post-shock differences in cash flow-based debt usage between matched PE- and non PE-backed firms then should reflect post-shock differences in access to cash flow-based debt.

We then run a series of loan-level regressions to compare similar loans that observably differ only by PE-backing. Due to the large number of fixed effects (discussed below), we

[14]One concern may be that the dramatic intervention of the Federal Reserve through corporate credit interventions and the Paycheck Protection Program may dampen the earnings shock following Covid-19. We do not believe this confounds our result since we are primarily exploiting cross-sectional variation in earnings shock from Covid-19 and because selection into regulatory liquidity provision programs is not correlated with characteristics that typically determine PE investment (size, industry, leverage etc.).

[15]One might worry that this may lead the control group to have too little of the debt type we are trying to match on. Table A2 in the Appendix reports the share of total bank credit commitments that are cash flow-based for this control group. As reported in row 3, we note that at least half of the firms in this sample relied exclusively on cash flow-based debt. However, we also ran a robustness test where we specified that the control group had issued cash flow-based debt equivalent to at least 5 percent of previous-year book assets in the calendar year preceding the earnings shock. This results in a slightly smaller control group but does not change our main result.

estimate the following linear probability model specification:

$$\mathbf{1}[CF\ Loan]_{l,i,b,t} = \zeta Post_t \times PE_i + \beta PE_i + Firm\ Controls_{i,t} + Loan\ Controls_{l,t} + FEs + \epsilon_{l,i,b,t}. \qquad (4)$$

In (4), the dependent variable equals 1 if a loan l issued by bank b to firm i in year-quarter t is cash flow-based, and 0 if asset-based. $Post_t$ equals 1 in the first four quarters of 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 pre-Covid-19. We retain only the post-buyout sample for PE-backed firms, since we focus on a relatively narrow time frame 2019-2020. PE_i is an indicator for PE-sponsored firms, taking value 1 (0) if firm i is (not) PE-backed at the beginning of our sample.

All regressions include firm controls (EBITDA, accounts receivables, inventory, tangibility, liquidity, log of book assets, and total quarterly credit commitments between a given bank-firm pair) and loan controls (interest rate, credit spread, maturity, risk rating, and loan purpose indicators). A loan's risk ratings are dummy variables capturing each quartile of a loan's default probability, as reported by a Y-14 Bank Holding Companies. Thus, we compare loans that are in similar risk buckets. Including credit spread, we also control for firm-specific characteristics that determine the firm's default risk. The inclusion of these loan controls implies that we implicitly also control for certain firm characteristics which determine a firm's borrowing and leverage. We also include various combinations of firm, bank-time, sector-time, and loan origination-time fixed effects. Thus, our identification of the coefficient ζ comes from comparing observably similar loans (in terms of observable borrower risk, lender characteristics, loan features, and aggregate conditions) to borrowers in the same industry-quarter, which likely only differ by whether the borrower is PE-backed.

Table 6 reports the results. The coefficient ζ is positive and significant. Thus, PE ownership raises a firm's likelihood of using cash flow-based debt post-shock. Columns (1) to (3) show that PE sponsorship is associated with approximately 5 percent higher probability of a bank loan being cash flow-based post-shock. The estimate is largest when we include both origination-time and sector-time fixed effects. We obtain nearly identical estimates when we estimate regression (4) only for firms with assets below \$ 500 billion.[16]

Given our matching procedure, we expect matched firms to have similar levels of cash flow-based debt outside of distress, i.e., whenever borrowing constraints are loose. Follow-

[16] In Table A5, we also alternatively include two additional loan-level controls: (i) loan utilization rate, which varies over time for credit lines, and (ii) expected utilization at default, which takes into account covenants and other contractual characteristics. We find that our results are robust to these controls. The expected utilization at default is statistically significant and negatively associated with the probability of issuing cash flow-based debt.

Table 6: Earnings Shock and Probability of Earnings-Based Debt

$Y_{l,i,b,t} : 1(CFLoan)$	Assets<$ 1 Bn			Assets< $ 0.5 Bn		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post \times PE$	0.053***	0.049***	0.048***	0.056***	0.051***	0.050***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
R-squared	0.688	0.695	0.697	0.697	0.705	0.707
Firm Controls	Y	Y	Y	Y	Y	Y
Loan Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Bank × Year-Qtr FE	Y	Y	Y	Y	Y	Y
Sector × Year-Qtr FE	N	Y	Y	N	Y	Y
Origination Year-Qtr FE	N	N	Y	N	N	Y
N	2.59e+05	2.59e+05	2.59e+05	2.33e+05	2.32e+05	2.32e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports estimates of linear probability model at the loan-quarter level, where the dependent variable is an indicator specifying if a loan issued by bank b to firm i in year-quarter t is cash flow-based or not. The sample runs from 2019:Q1 to 2020:Q4.* $Post_t$ *takes value 1 in the first four quarters of 2020, and* 0 *otherwise.* $PE_{i,t}$ *is an indicator that takes* 1 *if firm i is PE-backed in quarter t. All regressions include firm controls (EBITDA, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair) and loan controls (interest rate, credit spread, maturity, risk rating, loan type, and loan purpose). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

ing the earnings shock, non PE-backed firms are more likely to switch to asset-based debt. This suggests that the earnings shock curbs non PE-backed firms' access to cash flow-based debt to the extent that they (must) pledge assets to borrow, whereas PE-backed firms continue to borrow against cash flows. Put differently, private equity facilitates cash flow-based borrowing, and especially so in distress situations. Overall, our findings lend support to a supply-side explanation for why PE-backed firms use more cash flow-based debt: Non PE-backed firms have more asset-based debt, because their access to cash flow-based debt is limited. The engagement of PE sponsors, in turn, facilitates cash flow-based borrowing.

One additional concern related to our interpretation of a supply-side story could be related to loan pricing. That is, sponsors could be paying substantially higher spreads to obtaining financing in distress. Note that we already controlled for loan spreads in our regressions above. Nevertheless, we formally test the effect of PE and the joint effect of PE and usage of Cash Flow Based Debt on Loan Spreads and find : (i) that cash Flow based debt is no more expensive than asset-based debt in our sample and (ii) little evidence that PE sponsors are paying much higher spreads relative to non-PE to access cash flow based debt. These results are reported in Appendix Table A15.

3 Economic Mechanisms

The results of regression (4) suggest PE sponsors' involvement in distress resolution as a mechanism that enables cash flow-based borrowing. Intuitively, sponsors' involvement in distress helps to preserve the going-concern value of the firm, thus allowing it to borrow against future cash flows. We formalize this intuition in a theoretical model, which we describe below. Finally, we provide evidence that PE sponsors actively engage in distress resolution by (i) injecting equity and (ii) stabilizing earnings (via operational engineering).

3.1 Theory and Intuition

In Section 4.5, we present a simple two-period model which sheds light on the mechanisms that facilitate cash flow-based borrowing. We now verbally explain the intuition behind our theory. We consider a firm whose assets in place produce earnings ("EBIDTA") in the second period. The firm is owned by its shareholders, who maximize the value of the firm's equity. To enjoy a tax shield, the firm would like to raise debt financing from outside investors in the first period. However, the firm faces an endogenous borrowing constraint: The firm can borrow no more than it can credibly promise to repay (with probability one) in the final period after the earnings are realized.[17]

At an intermediate date in between the first and second period, with some probability, the firm is hit by a negative earnings shock which it may cover by raising costly outside equity financing at the time of the shock. Raising external equity financing is costly, as it leads to the dilution of the firm's existing shareholders.[18] If the firm does not cover the earnings shock, it liquidates, and creditors seize the firm's assets. If the firm raises external equity financing to continue operating as a going concern, creditors are repaid from the firm's earnings in the second period.

When the cost of external equity financing or the size of the earnings shock is large, the firm liquidates upon the earnings shock. To guarantee debt repayment despite liquidation, the firm can then borrow only up to the liquidation value of the assets. In this case, the firm faces an *asset-based* borrowing constraint. On the other hand, when the cost of raising equity is not too large, e.g., because the firm is PE-backed, or the size of the shock is small, the firm raises external equity financing to cover the earnings shock and continues operating until earnings are realized in the second period.

However, the firm faces a debt overhang problem when deciding whether to liquidate upon the shock: While external equity financing averts liquidation and, therefore, unambiguously benefits creditors, it dilutes the firm's existing shareholders (who in turn bear the cost of external equity financing). Upon the shock, the firm, maximizing shareholder value, optimally raises equity financing to avert liquidation only if outstanding debt relative to the firm's going-concern value (i.e., EBITDA) is not too large. For the firm to find it optimal to avoid liquidation, its borrowing constraint restricts Debt/EBITDA and so is *earnings-based*.

Private firms that are not backed by private equity have limited access to equity financing. According to our model, these firms use asset-based debt and face asset-based borrowing constraints. Their borrowing and borrowing constraints are insensitive to EBITDA. In contrast, PE-backed private firms have a lower cost of raising equity financing, and thus rely on cash flow-based debt with earnings-based borrowing constraints. Their borrowing constraints and borrowing are sensitive to changes in EBITDA.

The model highlights two key mechanisms that enable cash flow-based borrowing. First, PE sponsors provide liquidity support by injecting equity in distress situations, that is, after negative earnings shocks. Such equity injections in distress avert liquidation and allow the firm to continue as going-concern following the negative earnings shock. Second, PE sponsors engage with the firm and stabilize earnings (i.e., reduce the size of the earning shock). We

[17]The assumption that the firm can only finance with risk-free debt is for mere simplicity; similar results would obtain, if we allowed the firm to issue risky debt to risk-averse investors.

[18]In addition, due to a carry cost of cash reflecting agency conflicts of free cash (Jensen, 1986), the firm does not accumulate precautionary savings to cover the earnings shocks; see the model for details.

now provide empirical evidence supporting both mechanisms.

3.2 Mechanism: Liquidity Support through Equity Injection

To examine whether PE owners provide liquidity support in distress, we again exploit the Covid-19 shock as an exogenous earnings shock. We select the control group of non PE-backed firms by matching not only on the four variables described in Section 2.2, but also by restricting to those non PE-backed firms that had cash flow-based debt outstanding in the calendar year preceding the COVID-19 shock. This way, we compare firms with similar pre-shock reliance on cash flow-based debt. We then estimate a linear probability model:

$$\mathbf{1}(Equity\ Injection)_{i,t} = \zeta PE_{i,t} \times Post_t + \beta PE_{i,t} + \gamma X_{i,t} + FEs + \epsilon_{i,t}. \quad (5)$$

The dependent variable takes a value of 1 if firm i receives (positive) equity injection in year t and 0 otherwise. As Bernstein et al. (2019), we define equity injection as the difference of total equity in the past year minus profits. We define the variable $Post_t$, which takes a value of 1 in the calendar year 2020 and 0 in the calendar year 2019. We include both firm and industry×year fixed effects and cluster standard errors at the firm level. The sample is estimated over the period 2013-2020 and standard errors are clustered at the firm-level.[19]

Table 7 reports our results in buckets of firm size. PE-backed firms are significantly more likely to receive an equity injection following the Covid-19 shock than comparable non PE-backed firms. The estimates appear economically large, on average, ranging from 5 percent to 8 percent higher probability of receiving equity injection. Interestingly, the $PE_{i,t}$ indicator is statistically insignificant, suggesting that *matched* PE-backed and non PE-backed firms are not different in their propensity to raise equity financing in normal times.[20] Note that the point estimates are smaller for the full sample than for smaller firms, so private equity boosts equity injections relatively more for smaller firms. This is consistent with the view that larger firms can tap into various types of financing, thus relying less on equity injections.

3.3 Mechanism: Operational Engineering

To analyze whether PE sponsors stabilize earnings (via operational engineering), we study whether PE-backed firms experience lower decline in earnings following the Covid-19 shock

[19] In robustness tests we confirm our results hold for different pre-shock samples. For example, we also alternatively define the pre-Covid-19 sample from 2015-2019 onward and 2017-2019. Our results do not change. These are available on request.

[20] This could be because we match on cash flow-based debt pre-shock.

Table 7: Equity Injection following Earnings Shock

$Y_{i,t} : 1(Equity\ Injection)$	*Assets* < 1 *Bn*		*Assets* < 0.5 *Bn*		*Full Sample*	
	(1)	(2)	(3)	(4)	(5)	(6)
$PE \times Post$	0.063***	0.051***	0.064***	0.075***	0.054***	0.044***
	(0.019)	(0.019)	(0.021)	(0.021)	(0.015)	(0.015)
PE	-0.014	-0.012	-0.009	-0.013	0.008	0.008
	(0.015)	(0.015)	(0.017)	(0.017)	(0.011)	(0.011)
R-squared	0.321	0.337	0.343	0.327	0.279	0.291
Firm Controls	N	Y	N	Y	N	Y
Firm FE	Y	Y	Y	Y	Y	Y
Sector×Year	Y	Y	Y	Y	Y	Y
N	26442	26442	21295	21295	56792	56792

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports OLS estimates of regression specifications where the dependent variable is an indicator that specifies if a firm received an equity injection or not in a given year. Equity injection is constructed as the change in shareholder equity in year t minus net income for year t. Post takes value 1 in 2020 to capture a quasi-exogenous aggregate earnings shock and 0 in the pre-Covid-19 years. Firm controls include the natural log of book assets, return on assets, and leverage. Non PE-backed firms are selected from the matched sample such that they issued significant cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-code. Standard errors are clustered at the firm level.*

Table 8: Change in Earnings following Earnings Shock

$Y_{i,t}$: Δ *Earnings*	*Assets* < 1 *Bn*		*Assets* < 0.5 *Bn*	
	(1)	(2)	(3)	(4)
Post × *PE*	0.036*	0.040*	0.038*	0.043*
	(0.020)	(0.023)	(0.023)	(0.026)
PE	0.003	0.004	0.001	0.002
	(0.017)	(0.017)	(0.020)	(0.020)
R-squared	0.474	0.486	0.476	0.489
Firm FE	Y	Y	Y	Y
Year FE	Y	N	Y	N
Sector×Year	N	Y	N	Y
N	19757	19747	17691	17682

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports OLS estimates of regression specifications where the dependent variable is the change in earnings scaled by beginning-of-period total assets. Post takes value 1 in 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 in pre-Covid-19 years. Firm controls include the natural log of book assets, return on assets, and leverage. Non PE-backed firms are selected from the matched sample such that they issued significant cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-code. Standard errors are clustered at the firm level.*

relative to matched control firms, whereby matching procedure follows Section 3.2.[21] To do so, we regress the change in earnings (scaled by beginning of year book assets) on $PE_{i,t} \times Post_t$, whilst controlling for including various fixed effects and firm characteristics as controls.

The results are reported in Table 8. We find that PE-backed firms experience less drop in earnings compared to matched non PE-backed firms following Covid-19 shock. This suggests that PE sponsors stabilize their portfolio firms' earnings in distress (e.g., via operational engineering). We find similar results when we omit the matching on pre-shock use of cash flow-based debt, reported in Table A11. We also run the same regressions on the natural log of earnings and find similar results. Our results are only significant at the 10 percent level. An interpretation is that the equity injection channel is more relevant than the operational engineering channel.

Finally, one might be concerned that government support programs may have dampened the earnings shock resulting from Covid-19. Such programs include the Federal Reserve's primary and secondary market corporate credit facilities (Boyarchenko, Kovner, and Shachar, 2022; Gilchrist, Wei, Yue, and Zakrajšek, 2020), the Main Street Lending Program (Minoiu,

[21] That is, we match our control non PE-backed firms again on book assets, tangibility, liquidity, earnings. In addition, we also match on debt structure based on firms' use of cash flow-based debt pre-shock.

Zarutskie, and Zlate, 2021) and the Paycheck Protection Program (PPP) (Granja, Makridis, Yannelis, and Zwick, 2022). This would only be a problem if the targets of government support programs are systematically correlated with target firms of PE sponsors. We have reason to believe this is not the case.

First, most small firms in the U.S. do not issue bonds; hence, they lacked access to the Federal Reserve's bond programs. Second, the Main Street Lending Program only supplied $ 17.5 billion in capital through the program, or only 3 percent of its potential capacity which is unlikely to significantly affect our results.[22] Finally, anecdotal evidence suggests that PE-backed firms were largely ineligible to access the PPP program.[23] According to its rule, firms with fewer than 500 employees were eligible to tap into the program. However, the SBA additionally required that, if another entity owns a majority stake of a company, the number of employees of that entity should be counted as well for the firm's eligibility, meaning that most PE-owned firms could not qualify for it. That said, since this is only anecdotal evidence, we acknowledge that we cannot completely rule out that PE firms did receive PPP.

3.4 PE Sponsor Reputation and Cash Flow-Based Debt

PE sponsors with a higher reputation are generally associated with more advantageous loan terms for their portfolio firms (Ivashina and Kovner, 2011). Furthermore, we expect sponsors with high reputation (as measured by past deals) to have more dry powder, which can be injected in distress, or to be more skilled in improving firms' operations. Therefore, firms, backed by high-reputation PE sponsors, should have better access to cash flow-based debt relative to comparable firms not backed by high-reputation sponsors.

Using Pitchbook's sponsor identification information, we identify highly reputed sponsors in our sample using the top 30 PE sponsors listed by Private Equity International (PEI) between 2019-2020. We then generate a dummy called $Reputation_{i,t}$ which takes the value 1 for firms backed by high-reputation PE sponsors in quarter t and 0 otherwise (i.e., for firms that are not PE-backed or not backed by high-reputation PE sponsors in quarter t). We then estimate the the following regression (6):

$$\begin{aligned}\mathbf{1}[CF\ Loan]_{l,i,b,t} = \zeta Post_t \times Reputation_{i,t} + \beta Reputation_{i,t} \\ + Firm\ Controls_{i,t} + Loan\ Controls_{l,t} + FEs + \epsilon_{l,i,b,t}.\end{aligned} \tag{6}$$

We include the same fixed effects and loan-level and firm-level controls as in regression (4).

[22] See this article on Bloomberg.

[23] See the following article on PE-backed companies and SBA Paycheck Protection Program loans.

Table 9: Sponsor Reputation and Cash-Flow Based Debt

$Y_{i,t}$: 1(*CF Debt*)	Assets<$ 1 Bn			Assets< $ 0.5 Bn		
	(1)	(2)	(3)	(4)	(5)	(6)
Post × *Reputation*	0.086***	0.084***	0.084***	0.087***	0.086***	0.086***
	(0.018)	(0.018)	(0.018)	(0.023)	(0.023)	(0.023)
Reputation	-0.075	-0.084	-0.085	-0.041	-0.060	-0.056
	(0.065)	(0.067)	(0.067)	(0.077)	(0.078)	(0.078)
R-squared	0.688	0.695	0.697	0.697	0.705	0.707
Firm Controls	Y	Y	Y	Y	Y	Y
Loan Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Bank × Year-Qtr FE	Y	Y	Y	Y	Y	Y
Sector × Year-Qtr FE	N	Y	Y	N	Y	Y
Origination Year-Qtr FE	N	N	Y	N	N	Y
N	2.59e+05	2.59e+05	2.59e+05	2.33e+05	2.32e+05	2.32e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports the robustness of Table 6 by estimating the Eq. (6). We report estimates of linear probability model at the loan-quarter level, where the dependent variable is an indicator that specifies if a loan issued by bank b to firm i in year-quarter t is cash flow-based or not. The sample runs from 2019:Q1 to 2020:Q4. Post takes value 1 in the first four quarters of 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 pre-Covid-19. Reputation is an indicator for high-reputation PE-sponsored firms, defined in Appendix A. All regressions include firm controls (profitability, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair) and loan controls (interest rate, interest rate spread, maturity, risk rating, and loan purpose indicators). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Table A2 in the Appendix shows that this control group relied heavily on cash flow-based debt. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

Furthermore, we restrict our sample to PE-backed and non-PE-backed firms that had any cash flow-based debt in 2019 (similar to the procedure underlying regression (4)).

Table 9 reports the results. Being backed by a high-reputation PE sponsor raises the probability of a loan being cash flow-based following a negative shock ranges between 8.4 to 8.7 percent. The effect of $Post_t \times Reputation_{i,t}$ in regression (6) is around 3 percentage points higher than the effect of $Post_t \times PE_{i,t}$ in (4) on the probability that a loan is based on cash flows (reported in Table 6). Note that our "control" sample in (6) also includes PE-backed firms not backed by high-reputation sponsors. In Appendix Table A14, we conduct further heterogeneity analysis by estimating this same regression only within the PE-sample and find similar results.

Thus, while PE sponsors in general relax financing constraints by facilitating cash flow-based borrowing, high-reputation sponsors are more effective at doing so. Because high reputation may proxy for a PE sponsor's ability to inject equity or to stabilize earnings in distress, these findings provide further evidence that sponsors' liquidity support and operational engineering in distress are key to improving access to cash flow-based debt.

4 Other Results and Robustness

4.1 Earnings Sensitivity of Total Debt

Our baseline analysis mainly focuses on private firms' bank debt reported in the Y-14 data. The reason is that the Y-14 data give us detailed information about loan terms and collateral, allowing us to classify bank loans into asset- and cash flow-based. Such information is generally not available for loans from non-bank lenders, i.e., we cannot observe the collateral backing loans from non-banks. Nevertheless, our data allow us to calculate firms' level of total debt (the sum of bank and non-bank debt). To highlight robustness and external validity of our results, we show that PE ownership is associated with significantly higher sensitivity of *total debt* to changes in earnings.

In more detail, we estimate the regression equation (3) with changes year-over-year in total debt as the outcome variable. Table 10 reports the results. PE backing raises the sensitivity of total debt (issuance) to changes in earnings. For PE-backed firms, a one unit increase in EBITDA is associated with between 20 and 24 percent additional increase in net debt issuance. The estimated coefficients are significant at 1% level among firms with assets below \$ 1 billion, and are significant at 5% or 10% if we further restrict the sample to firms with assets below \$ 500 million. These estimates appear economically large and comparable to the those obtained in studies of large and public firms (Lian and Ma, 2021).

Table 10: Matched Diff-in-Diff Estimates: Total Debt Issuance and Capital Expenditures

Panel A: Δ *Debt*	*Assets* < $ 1 *Bn*		*Assets* < $ 0.5 *Bn*	
	(1)	(2)	(3)	(4)
$PE \times EBITDA$	0.240***	0.241***	0.209**	0.207*
	(0.076)	(0.078)	(0.104)	(0.122)
$EBITDA$	0.081*	0.068*	0.043	0.037
	(0.042)	(0.036)	(0.079)	(0.101)
R-squared	0.201	0.213	0.214	0.228
Firm Controls & FE	Y	Y	Y	Y
Bank×Year FE	Y	Y	Y	Y
Sector×Year	N	Y	N	Y
N	26229	26221	21401	21392

(a) *This table reports estimates of various outcome variables on an interaction between PE-ownership and firm earnings proxied by EBITDA/beginning of year book assets. The outcome variable is net debt issuance (i.e. year-over-year change in total debt) scaled by lagged assets. The matched control group is constructed as outlined in Section 2.2. In the first two columns, we define small firms as those with book assets less than $ 1 billion, and in the last two columns as those with book assets less than $ 0.5 billion. Firm controls are the same as reported in Table 3. Sector FE is defined as the 2-digit NAICS-code. Standard errors are clustered at the borrower level.*

Our findings indicate that PE-backed firms' reliance on cash flow-based debt is not limited to banks as lenders. Because PE-backed firms' total debt is highly sensitive to changes in earnings, we conclude that their borrowing (from banks and non-banks) is to large extent cash flow-based. In contrast, non PE-backed firms rely more on asset-based debt, i.e., exhibit lower sensitivity of total debt to earnings.

4.2 Earnings Sensitivity of Debt for PE-Backed Firms

Our baseline difference-in-differences analysis utilizes a sample consisting of matched PE- and non PE-backed firms to examine how private equity affects firms' borrowing. For robustness, we now perform separate analysis for the subsample of PE-backed firms only. We show that PE-backed firms' borrowing from banks is highly sensitive to changes in earnings. For this sake, we run the following OLS regression at the firm-bank-year level:

$$y_{i,b,t} = \beta EBITDA_{i,t} + \gamma X_{i,t}^{'} + FEs + \epsilon_{i,b,t}, \qquad (7)$$

where the dependent variable $y_{i,b,t}$ is the *level* of total credit commitment from bank b to firm i in year t scaled by firm i's book assets in year $t-1$. We include bank-time ($\eta_{b,t}$) and firm (α_i) fixed effects as well as control for various firm characteristics ($X_{i,t}$). Regression

(7) is similar to the baseline regression in Lian and Ma (2021), but differs as it is at the firm-bank-year level and focuses on PE-backed firms.

Table A13 presents the results. In the first two columns (1) and (2), we define small firms as those with book assets below \$ 1 billion. In columns (3) and (4), we define small firms as those with book assets less than \$ 500 million. Overall, PE-backed firms exhibit a high sensitivity of debt to changes in earnings. A one unit increase in EBITDA is associated with around 21 to 23 percent increase in firm-level bank credit. These findings again highlight that PE-backed firms rely extensively on cash flow-based debt financing.

Although the Y-14 data cover the vast majority of corporate loans in the U.S., one concern could be that our sample lacks PE-backed firms that mostly borrow from non-bank lenders and private debt funds.[24] For robustness, we now provide evidence that our findings also extend to PE-backed firms that predominantly borrow from non-ban lenders. To do so, we use the database of Jang (2022) on PE-backed firms borrowing from non-bank lenders. We then investigate whether those firms' debt and capital expenditures are sensitive to changes in earnings by estimating the firm-level regression:

$$y_{i,t} = \beta EBITDA_{i,t} + \gamma X_{i,t} + FEs + \epsilon_{i,t}.$$

Table A16 reports the summary statistics of this new sample, and Table A17 reports the regression results. An increase in one unit of EBITDA is associated with a 0.26 unit increase in net debt issuance, 0.04 unit increase in capital expenditures and 68% increase in asset growth. The estimated coefficients for those with assets below \$ 500 million are 0.26, 0.4, and 62%, respectively. All estimation results are significant at 5% or 1% levels, except for the estimates on capital expenditures of firms with assets below \$500 million (significant at 10% level). Thus, just like PE-backed firms that predominantly borrow form banks, those that predominantly rely on non-bank lending also exhibit high sensitivity of their borrowing issuance and investments to changes in earnings. This suggests that their borrowing is to large extent cash flow-based.

[24] Since the 2008 financial crisis, commercial banks faced tighter regulation and, therefore, reduced its lending to smaller and riskier firms in favor of unregulated, non-bank institutions (Erel and Inozemtsev, 2022). As a result, direct lenders, comprising private credit funds and business development companies, have become an important source of debt financing for leveraged buyouts of small and middle-market firms (Jang, 2022; Block et al., 2022). Jang (2022) studies a proprietary data set of loan contracts of PE-backed firms and finds that direct lenders use more cash flow-based debt than banks.

Table 11: Aggregate Income Shock and Probability of continued access to Unsecured Debt

$Y_{i,t}$: $1(Unsecured)$	Assets<$ 1 Bn			Assets< $ 0.5 Bn		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post \times PE$	0.033***	0.033***	0.032***	0.036***	0.051***	0.034***
	(0.004)	(0.003)	(0.003)	(0.004)	(0.007)	(0.004)
R-squared	0.802	0.805	0.807	0.805	0.706	0.810
Firm Controls	Y	Y	Y	Y	Y	Y
Loan Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Bank × Year-Qtr FE	Y	Y	Y	Y	Y	Y
Sector × Year-Qtr FE	N	Y	Y	N	Y	Y
Origination Year-Qtr FE	N	N	Y	N	N	Y
N	2.59e+05	2.59e+05	2.59e+05	2.33e+05	2.32e+05	2.32e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports estimates of linear probability model at the loan-quarter level, where the dependent variable is an indicator specifying if a loan issued by bank b to firm i in year-quarter t is unsecured or not. The sample runs from 2019:Q1 to 2020:Q4.* $Post_t$ *takes value 1 in the first four quarters of 2020, and 0 otherwise.* $PE_{i,t}$ *is an indicator that takes 1 if firm i is PE-backed in quarter t. All regressions include firm controls (EBITDA, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair), loan controls (interest rate, interest rate spread, maturity) and loan fixed effects (risk rating, loan type and loan purpose). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the borrower-level.*

4.3 Private Equity and Borrowing Constraints in Distress

Our previous results indicate that in distress situations (e.g., following a negative earnings shock), PE-backed firms have better access to cash flow-based debt than similar non PE-backed firms. Thus, non PE-backed firms pledge specific assets as collateral to obtain debt financing in distress, while PE-backed firms can borrow without doing so. Following this logic, we also expect that in distress, PE-backed firms are more likely to finance with unsecured debt than similar non PE-backed firms.

To test this hypothesis, we estimate, similar to regression (4), the following loan-level regression:

$$\mathbf{1}[Unsecured\ Loan]_{l,i,b,t} = \zeta Post_t \times PE_{i,t} + \beta PE_{i,t} + Firm\ Controls_{i,t} + Loan\ Controls_{l,t} + FEs + \epsilon_{l,i,b,t}, \quad (8)$$

where the dependent variable is an indicator equal to 1 if and only if loan l from bank

b to firm i is unsecured in year-quarter t. We use the same matching procedure as when estimating (4) and include the same control variables and fixed effects. The only difference between the regressions (4) and (8) is the dependent variable, which in (4) is an indicator equal to one when the loan is cash flow-based (unsecured or backed by blanket lien).

Table 11 presents the results. The coefficient ζ is positive and highly significant, ranging from 0.032 to 0.051. That is, following the Covid-19 earnings shock, PE-backed firms are more likely to use unsecured debt than non PE-backed firms. We conclude that in distress, PE-backed firms continue to have access to unsecured debt, whereas non PE-backed firms pledge collateral and obtain secured debt financing. That is, private equity improves access to unsecured debt in distress situations.

4.4 Alternative Matching Procedures

We show that our results are robust to alternative matching procedures.

First, we consider whether our baseline bank credit sensitivity results in Table 3 are robust to alternate firm-level matching. Initially, we matched non PE-backed firms to PE-backed firms on size, tangibility, profitability, and leverage (Section 2.2). Although this initial matching yielded a similar distribution of ex-ante liquidity between PE-backed and matched non PE-backed firms (as shown in Table A1), we still consider whether our results change after additionally matching on ex-ante liquidity. Table A8 reports the new balance test results, and table A9 reports the baseline results using the new matched sample. The estimated coefficients on $PE \times EBITDA$ hardly changes from before. Interestingly, the estimated coefficients on $EBITDA$ are now significant at 5%, but the magnitudes are three times smaller than those on $PE \times EBITDA$ (0.02).

Second, we consider whether our COVID-19 test results in Table 6 (Section 2.5) are robust to using a different pre-shock sample. To mitigate a concern for any systematic issues that might have happened in 2019, we expand the pre-shock sample to firms that issued any cash flow-based debt since 2018 (instead of 2019). As Table A10 reports, the estimated coefficients decrease approximately 1% to 3-4% (from 4-5%), but remain statistically significant at 1%.

4.5 Simple Theoretical Framework

We provide a stylized theoretical framework to illustrate how (i) equity injections and (ii) operational engineering by PE investors facilitate access to cash flow-based debt and raise the sensitivity of debt issuance to earnings. The model is kept purposefully simple.

4.5.1 Model

There are three time periods, $t = 0, 1, 2$. All payoffs are discounted using the common (per period) risk-free rate $r > 0$, so the discount factor is equal to $1/(1+r)$. We define the two-period risk-free rate as $r_2 := (1+r)^2 - 1$.

There is a single firm with assets in place that produce cash flow ("EBITDA") E at time $t = 2$. The liquidation value of the firm's assets is $A \geq 0$.[25] At the intermediate date $t = 1$, the firm experiences a negative cash flow shock or shortfall ("loss") of $L \geq 0$ dollars with probability $p \in (0, 1)$; otherwise, with probability $1 - p$, there is no cash flow shock at all in $t = 1$. This cash flow shock could capture an unexpected drop in earnings or unexpected costs the firm incurs (e.g, due to a lawsuit). If the firm cannot raise L dollars to cover this cash flow shortfall, it must liquidate. Liquidation is inefficient, in that we assume throughout $E > (1 + r_2)A$.

We consider that the firm does not accumulate precautionary cash holdings, an assumption that we relax in the Appendix A4. This assumption reflects that holding cash is costly and there are carry costs of cash that outweigh the precautionary benefits from holding cash, e.g. due to agency problems associated with free cash and cash flow (Jensen, 1986; Bolton, Chen, and Wang, 2011; Hartman-Glaser et al., 2023).[26]

We allow the firm to raise new equity from outside investors at time $t = 1$ to cover the negative cash flow shock, but external equity financing is costly, a common assumption in the corporate finance literature (Hennessy and Whited, 2007; Bolton et al., 2011). In this literature, the cost of external equity financing captures in reduced form asymmetric information or agency problems associated with external financing. Specifically, to avoid liquidation upon the cash flow shortfall at $t = 1$, the firm can raise Δ dollars of external equity financing at a fixed cost of $\delta \geq 0$.[27] Default occurs at $t = 1$ if and only if the firm experiences a cash flow shortfall and does not raise sufficient equity, i.e., $\Delta < L$. The firm cannot raise any other form of financing at $t = 1$. Provided the firm raises equity to avert liquidation upon the cash flow shortfall, it raises without loss of generality $\Delta = L$ dollars (raising more equity does not improve payoffs).[28] Importantly, notice that for private firms,

[25] That is, the firm's past EBIDTA (taken as given at onset) is informative about future cash flow and EBITDA, in that EBITDA at $t = 2$ equals E with probability one.

[26] Indeed, as we show in Appendix A4, the firm finds it optimal not to hold precautionary cash, if cash holdings earn a rate of return below r (e.g., due to agency problems, as in Bolton et al. (2011)), the probability of a cash flow shortfall p is relatively low and / or the cost of raising equity δ is low.

[27] The assumption that cost of equity financing is a fixed cost is without loss of generality. We could equally stipulate $\delta := \delta_{Fixed} + \delta_{Variable}\Delta$ to introduce fixed and variable cost of equity issuance, while our results would remain unchanged.

[28] Raising more than L dollars of new equity is redundant, and the firm would pay out any additional dollar raised as equity as dividend. Thus, without loss of generality, one considers that the firm merely raises a maximum of L dollars of equity at $t = 1$.

external equity financing is typically only available from PE investors. Therefore, within our framework, low or zero costs of external equity financing are associated with PE ownership or a PE sponsor backing the firm, while non PE-backed firms would be characterized by higher values of δ.

The firm's earnings E in $t = 2$ are subject to the corporate tax rate $\tau \in (0, 1)$. Coupon and interest payments are tax-deductible, giving rise to a tax shield and introducing a motive to issue debt. At time $t = 0$, the firm can raise debt from competitive investors. The debt pays back the face value D and the interest at maturity at time $t = 2$. The per period interest rate on debt r_D is endogenous.[29] Debt is priced at par at issuance, so the interest rate r_D is such that the time-0 price of debt equals the face value D. If the firm experiences a cash flow shortfall at time $t = 1$ and liquidates, it defaults on its debt. Debtholders are senior vis-a-vis equity holders in the event of default at time $t = 1$, in which case they receive $\max\{D(1 + r_D), A\}$ where A is the liquidation value of the firm. Thus, the equity holders receive $[A - (1 + r_D)D]^+ := \max\{A - (1 + r_D)D, 0\}$ upon liquidation in $t = 1$; we write $[K]^+$ for $\max\{K, 0\}$ for the scalar K. We denote by q the endogenous probability with which the firm liquidates and defaults on its debt *conditional* on experiencing cash flow shortfall at $t = 1$.[30]

We assume that investors are only willing to provide debt financing as long as the debt is free from default risk. In other words, we restrict our attention to risk-free debt. The interest rate (per period) of debt r_D therefore does not reflect any risk compensation and is equal to r per dollar of debt (i.e. $r_D = r$), thus compensating debt investors for their time preferences. That is, debt pays $(1 + r_2)D$ at time $t = 2$, where $r_2 = (1 + r)^2 - 1$ is the two-period interest rate. For debt to be free from default risk, debt (face) value must satisfy

$$D(1 + r) \leq A \quad \text{if} \quad q > 0. \tag{9}$$

The constraint (9) states that if the firm is liquidated at $t = 1$ with positive probability, then the liquidation value of the assets A must be sufficient to pay the face value D plus the one-period interest payments rD. Moreover, the cash flow at $t = 2$ must be sufficient to repay debt, i.e., $D(1 + r_2) \leq E$ (this constraint will never bind in equilibrium).

If the firm raises D dollars of debt at time $t = 0$, then at $t = 2$ its earnings V_2 *after*

[29]Without loss of generality, the per-period interest rate is constant over time.

[30]Since p is the probability of a cash flow shortfall at $t = 1$, the unconditional probability of liquidation/default equals pq.

interest payments and taxes (i.e., the firm's equity value in $t = 2$) equal:

$$V_2 = (E - r_2 D)(1 - \tau) = \underbrace{E(1-\tau)}_{\text{Cash flow after tax}} - \underbrace{r_2 D}_{\text{Interest payment}} - \underbrace{D}_{\text{Principal}} + \underbrace{r_2 \tau D}_{\text{Tax shield}} . \tag{10}$$

Thus, the firm enjoys a tax shield $r_2 \tau D$ that makes it beneficial for the firm to issue debt $D > 0$ at time $t = 0$. The shareholders of the firm maximize at any point in time t the value of the firm's equity.equity.equity. We now formally state the firm's optimization in $t = 0$ and $t = 1$ respectively, and characterize the solution to the model starting from period $t = 1$.

Period $t = 1$. We now study the firm's problem in $t = 1$, taking the level of outstanding debt D (chosen at $t = 0$) as given. Suppose the firm experiences a cash flow shortfall of L dollars at $t = 1$. The firm liquidates and defaults on its debt if it does not raise at least L dollars of equity financing. If it does raise $\Delta = L$ dollars of equity to prevent liquidation and default (and incurs the fixed cost of equity issuance δ), its continuation value net of the cost of equity financing becomes[31]

$$\frac{V_2}{1+r} - L - \delta. \tag{11}$$

Therefore, the firm does not liquidate upon cash flow shortfall (and $q = 0$) if and only if this net continuation value from (11) exceeds the period-1 liquidation value of equity $\max\{A - (1+r)D, 0\} = [A - D(1+r)]^+$, that is, if and only if $X \geq (L + \delta + [A - (1+r)D]^+)(1+r)$. As such, conditional on experiencing a cash flow shortfall, the firm's endogenous probability of liquidation/default q satisfies

$$q = \begin{cases} 0 & \text{if} \quad V_2 \geq (L + \delta + [A - (1+r)D]^+)(1+r) \\ 1 & \text{if} \quad V_2 < (L + \delta + [A - (1+r)D]^+)(1+r), \end{cases} \tag{12}$$

Notice that the probability of default upon cash flow shortfall q also affects the firm's borrowing constraint in (9).

Period $t = 0$. In period $t = 0$, the firm issues debt and pays out the proceeds as dividends to shareholders. The firm then chooses its capital structure to maximize initial equity value

[31] Again, recall that raising more than L dollars of new equity does not improve payoffs. It is without loss of generality that the firm raises L dollars of equity at $t = 1$ when it averts liquidation.

or, equivalently, initial firm value:

$$\max_{D\geq 0}\left\{D+\frac{1}{1+r}\left[(1-p)\left(\frac{V_2}{1+r}\right)+p(1-q)\left(\frac{V_2}{1+r}-L-\delta\right)+pq[A-(1+r)D]^+\right]\right\}, \tag{13}$$

subject to (9) and (12) as well as $D(1+r_2)\leq E$. Recall that the firm's equity value V_2 in $t=2$ (provided it is not liquidated before) is defined in (10). To understand the expression for the initial value of the firm in (13), note that the firm raises D dollars of debt financing at $t=0$ which are paid as dividends to shareholders. In period $t=1$, the firm experiences a cash flow shortfall with probability p in which case the firm liquidates with probability q and shareholders obtain the liquidation value $[A-(1+r)D]^+$. With probability $p(1-q)$, the firm experiences a cash flow shortfall and raises L dollars of equity at fixed cost δ to avoid liquidation, which yields the value of the firm's equity V_2 in $t=2$. Finally, with probability $1-p$, there is no cash flow shock and the firm survives with equity value V_2 in $t=2$.

The following Proposition presents the model outcomes.

Proposition 1. *In optimum, there exists a threshold $\overline{\delta}>0$ such that the firm's optimal debt level/issuance equals*

$$D=\begin{cases} A\left(\frac{1}{1+r}\right) & \text{if} \quad \delta>\overline{\delta} \\ \Big(E(1-\tau)-(1+r)(L+\delta)\Big)\left(\frac{1}{1+r_2(1-\tau)}\right) & \text{if} \quad \delta\leq\overline{\delta}. \end{cases} \tag{14}$$

The default probability is equal to $q=1$ for $\delta>\overline{\delta}$ and $q=0$ for $\delta\leq\overline{\delta}$. The threshold $\overline{\delta}$ strictly decreases with L.

The proof of Proposition 1 can be found in Appendix A4.

4.5.2 Analysis: Linking Theory and Empirics

Overall, Proposition 1 highlights the liquidity support of PE sponsors (equity injections) and operational engineering to stabilize earnings as key mechanisms behind the superior access of PE-backed firms to cash flow-based debt.

More in detail, Proposition 1 shows that the equilibrium debt issuance is a function of the cost of issuance of equity δ. We interpret the lower values of δ as prevailing for PE-backed firms, because PE-backed firms can tap into equity financing from their PE owners more easily than non PE-backed ones. Furthermore, it seems plausible that firms supported by high-reputation PE sponsors (see Section 3.4) face lower equity issuance costs δ. On the other hand, non PE-backed firms are characterized by a large value of δ, as non PE-backed private companies typically cannot access outside equity financing.

The intuition behind Proposition 1 is as follows. When the firm has no access to sufficiently cheap equity financing (that is, large δ), it defaults upon negative cash flow shock at $t = 1$ (that is, $q = 1$). Thus, for a non PE-backed firm characterized by large $\delta > \overline{\delta}$, the borrowing constraint (9) applies and the value of the firm's assets A constrains the debt issuance at $t = 0$, i.e., the firm faces an asset-based borrowing constraint. To exploit the tax shield, the firm issues debt as much as the borrowing constraint allows. As a consequence, (9) binds and debt issuance D is sensitive to asset value A but not EBITDA E, i.e., $\frac{\partial D}{\partial A} > 0$ and $\frac{\partial D}{\partial E} = 0$.

Next, we consider a firm with a low cost of equity financing, i.e., $\delta \leq \overline{\delta}$. As outside equity financing for private firms is typically provided by PE investors, we interpret this firm as one that is PE-backed or PE-owned. Then, the optimal level of debt increases linearly with the firm's EBITDA E, readily implying ourlinear regression (7). Under these circumstances, the firm does not default and raises equity financing to cover any cash flow shortfall in $t = 1$. The level of debt D is then such that the firm indeed has sufficient incentives to avert default and liquidation (i.e., to set $q = 0$) by raising equity, so that the incentive constraint (12) must hold. As the firm's incentives to prevent liquidation increase with the going-concern value of the firm and thus with EBITDA E, the resulting borrowing constraint, restricting the choice of D, is based on EBITDA. In other words, the firm faces an earnings-based borrowing constraint. Again, to exploit the tax shield, the firm issues debt to the point that this borrowing constraint binds. In line with our empirical findings, debt issuance D is therefore sensitive to EBITDA, i.e., $\frac{\partial D}{\partial E} > 0$, but $\frac{\partial D}{\partial A} = 0$.

In short, the firm's debt is asset-based, if $\delta > \overline{\delta}$, and cash flow-based, if $\delta \leq \overline{\delta}$. PE-backed firms are characterized by a lower cost of equity issuance δ. Notably, Proposition 1 suggests the following linear relationship:

$$D = \alpha + \beta \; EBITDA \times PE + \gamma A, \tag{15}$$

with $\beta > 0$ and $PE := \mathbf{1}\{\delta \leq \overline{\delta}\}$. Under the interpretation that PE-owned firms have a lower equity issuance cost δ (in particular, $\delta < \overline{\delta}$), we see that (15) exactly yields our baseline regression specification (1).

5 Conclusion

How do private equity buyouts affect firms' debt structure and borrowing constraints? In this paper, we show that private equity relaxes financing constraints by enabling PE-backed firms to borrow against future cash flows using cash flow-based debt. We construct a large and novel database of U.S. buyouts with detailed loan-level and collateral information that allows us to shed light on private firms' capital structure. Unlike comparable non-PE-backed firms that primarily use asset-based debt, PE-backed firms rely extensively on cash flow-based debt with earnings-based borrowing constraints. As such, their borrowing and investments are highly sensitive to changes in earnings. That is, private equity raises both the level and the cash flow sensitivity of leverage. Our findings indicate that PE-backed firms tend to borrow more against cash flow due to better access to cash flow-based debt. Documenting that PE owners inject equity and stabilize earnings in distress, we highlight that PE sponsors' involvement in distress is key to improving access to cash flow-based debt.

By combining the Federal Reserve's Y-14 data with buyout deals from Pitchbook, our paper constructs one of the largest data sets of private equity buyouts in the U.S. with detailed financial and accounting information. A unique and distinguishing feature of our data is the information about the collateral backing individual loans. The collateral information allows us to classify loans into asset-based (secured by a specific asset) and cash flow-based (unsecured or secured by blanket lien). This classification is central to our analysis: It enables us to shed light on firms' debt structure and borrowing constrains which crucially depend on the type of debt financing used. In particular, our data also cover small and middle-market firms that are underrepresented in other data sets. Going forward, our data can be used in other empirical studies to analyze the effects of private equity buyouts, for instance, on firm outcomes.

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Appendix

A Variable Definitions

We provide definitions of our main variables below. Following Brown et al. (2021), - also based on Y-14 data - we generally scale financial variables by beginning-of-period total assets, apart from total assets itself. Below we present variable definitions. The item numbers of the data fields refer to Schedule H1 of the Y-14Q data on the Federal Reserve's website: https://www.federalreserve.gov/reportforms/forms/FR_Y-14Q20160930_i.pdf

- Firm Size: Natural Log of Book value of current year assets
- EBITDA: EBITDA/Book value of beginning-of-period total assets. Also referred in main text as earnings or firm profitability.
- Capex: Capital Expenditure/beginning-of-period total assets
- Total Debt: Total Debt/Book value of beginning-of-period total assets
- Total Bank Credit: Total Commitments of bank b to firm f (Y-14: CLCOG074) in year t scaled by beginning-of-period asset. These include all types of loans such as revolving credit lines or term loans.
- Change in Bank Credit: Annual Change in Total Bank Credit/Book value of beginning-of-period total assets.
- Cash flow-based debt: Debt based on the value of cash flow from the firm's continuing operations or going-concern value. Identified directly from security used to back the loan. We follow Lian and Ma (2021) and categorize blanket liens or unsecured debt as cash flow-based debt.
- Asset-based debt: Debt based on liquidation value of specific assets such as real estate, equipment, inventory, receivables, cash etc. Identified by observing the security type used to back the loan.
- Equity Injection: Indicator variable taking value 1 if change in equity minus profit in a given firm-year is positive.
- Loan Maturity: Computed as the difference between loan maturity date and loan origination date (expressed in years)
- Utilization rate: Total utilized exposure/Total Commitments for a given loan-time observation.
- Expected Utilization at Default (EAD): Bank reported exposure at default, taking into account loan contract details.
- Loan Risk: Dummies for default probability quartiles. Time-varying probability of default is reported by each Y-14 Bank holding Company, and is typically a function of firm characteristics and aggregate conditions.

- Loan Type: Dummies for different types of loans. Specifically, it is a variable that takes value 1 for a Revolving Credit Line, 0 otherwise. Similarly, a variable which takes value 1 for Term Loans, 0 otherwise.
- Loan Purpose: Dummies for whether a loan is used for acquisition, refinancing etc.
- High reputation PE sponsor: Dummy variable taking value 1 for top 30 PE sponsors listed in Private Equity International (PEI) in 2019-2020 that sponsor loans in the Y-14Q sample.

B Y-14 Data Cleaning

- We roll up loans to subsidiaries to the parent company-level if banks report parent company rather than subsidiary financial information. Following Greenwald, Krainer, and Paul (2021) and Chodorow-Reich, Darmouni, Luck, and Plosser (2022), we identify distinct firms using Taxpayer Identification Number. This addresses the issue that the same firm can borrow from multiple banks and banks have idiosyncratic differences in how they name a particular borrower.

- The raw data is winsorized at the 2.5 and 97.5 percent levels.

- Following Brown et al. (2021), we exclude financial statement information if the financial statement date is missing or comes later than the data report date. We also exclude likely data errors by requiring that for each firm and financial statement date: (i) EBITDA does not exceed net sales, (ii) fixed assets exceed total assets, (iii) cash and marketable securities do not exceed total assets, (iv) long-term debt does not exceed total liabilities, (v) short-term debt does not exceed total liabilities, (vi) tangible assets do not exceed total assets, (vii) current assets do not exceed total assets, and (viii) current liabilities do not exceed total liabilities.

- Next, when we use information about the facility type (credit line or term loan), collateral pledged or interest rate variability type (i.e., fixed or floating), we exclude observations for which this information is missing or changing over the facility history.

- Observations with negative or zero values for committed exposure, negative values for utilized exposure, and with committed exposure less than utilized exposure are excluded (there are very few such errors).

- Finally, we verify that the distribution of key variables in our full Y-14 sample is reasonably consistent with previous studies that use Y-14 such as Favara, Minoiu, and Perez-Orive (2022), Brown et al. (2021) or Greenwald et al. (2021). For example, we find that the average credit line as a share of beginning-of-period total assets in our sample is 26 percent between the 2012-16 period, while Brown et al. (2021) find it is 24 percent during that period.

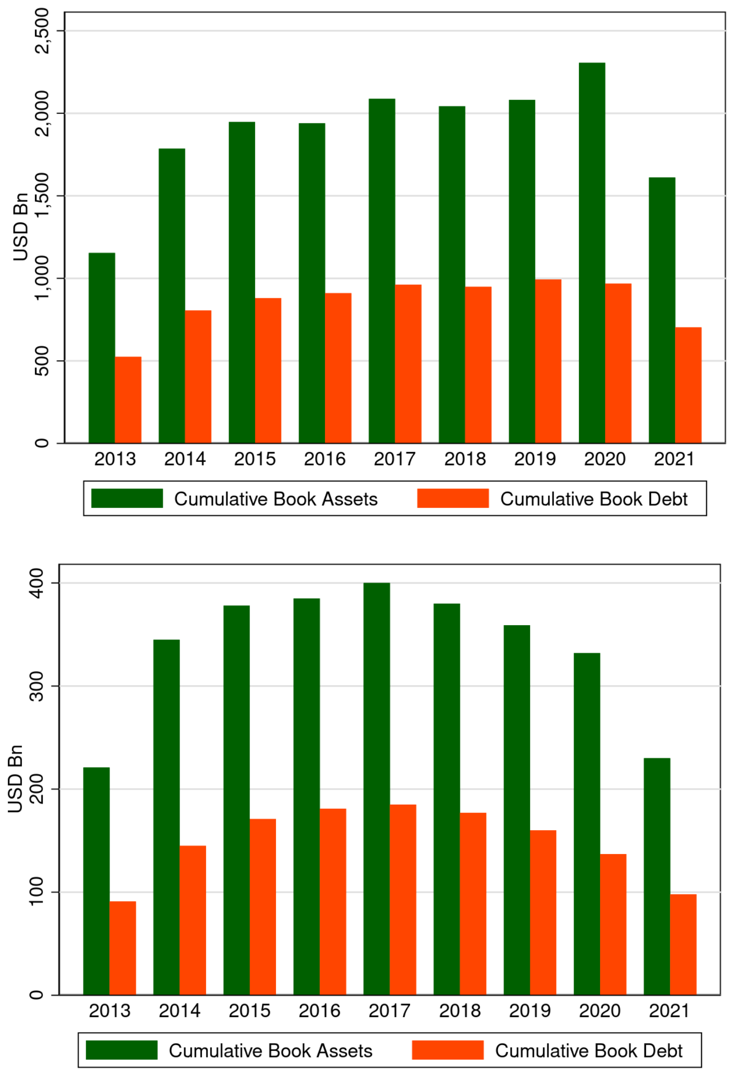
C Additional Figures and Tables

Table A1: Comparison between PE and Matched Non PE-backed Sample

Matching Covariates	PE Sample		Matched Sample			
	Mean	SD	Mean	SD	Mean diff.	Standardized Bias
Log Size	18.6	2.2	18.4	2.6	0.2	8.4
Tangible Assets	73.4	28.2	73.9	26.1	-0.5	-2.5
Debt/assets (leverage ratio)	45.1	35.8	43.3	33.5	1.8	-4.6
EBITDA	15.8	96.7	15.4	81.4	0.4	0.5
Other Characteristics					0	
Liquidity	8.2	11.9	7.5	9.6	0.7	7.6
Sales/Asset	2.20	2.9	1.8	3.3	0.4	1.6

(a) *Notes: This table reports covariate balance tests between PE-backed and matched non PE-backed firms. It also shows that the standardized bias between each matching variable is within a 20 percent bracket between treatment (PE-backed firms) and control group. Standardized bias (in percentages) is computed as the difference in means between the two groups, divided by the standard deviation of the treatment group. Matching is executed* within *each 2-digit NAICS industry in time* $t-1$*, where* t *is the year of the buyout. All variables are expressed in percentages, except for Log Size (in millions of USD) and Sales/Asset which is a fraction.*

Figure A2: Cumulative Book Assets and Debt



(a) *Notes: This chart plots the cumulative book assets and book debt over each calendar year on the initial merged sample, aggregated over distinct PE-backed firms. The top panel reports the full sample and the bottom panel restricts to firm-years with assets below $ 1 billion. Because Bank Holding Companies differ in the timing of their reporting, our coverage of firms in 2021 is relatively smaller at the time the data was retrieved.*

Table A1: Industry Distribution

Sector	Broad NAICS Code	Share of Sample
Agriculture	1	0.4%
Mining, Utilities, Contruction	2	7.3%
Manufacturing	3	29.4%
Trade, Transportation and Warehousing	4	25.7%
Information, Professional, Scientific	5	28.9%
Education and Healthcare services	6	4.9%
Arts, Entertaintment and Accomodation	7	2.3%
Other Services	8	1.1%

(a) *Notes: This table reports sectoral decomposition of the PE-backed bechmark sample using 1-digit NAICS codes. The decomposition is at the firm-year level.*

Table A2: Earnings Based Debt in Debt-structure matched Non PE-backed Sample

Share of Firms with more than 50 percent CF-debt in Total Bank Debt	62.8%
Share of Firms with more than 75 percent CF-debt in Total Bank Debt	55.2%
Share of Firms with more than 90 percent CF-debt in Total Bank Debt	52.4%
Share of Firms with 100 percent CF-debt in Total Bank Debt	51.2%

(a) *Notes: This chart tabulates the share of cash flow based debt in total bank debt of the debt-structure matched control firms constructed as described in Section 2.5.*

Table A3: Full Sample: Post-Buyout

Post-Buyout	N	Mean	SD	p25	p50	p75
Total Assets	15,189	1,240	3,310	45.9	202	837
Sales/Assets	15,189	1.7	2.4	0.65	1.18	1.97
Tangibility	15,189	62.3	29.8	36.4	61.5	94.4
Receivables	15,189	15.2	14.4	5.2	11.3	20.6
Inventory	15,189	12.7	16.4	0.1	6.2	19.2
Cash	15,189	5.9	9.1	1.01	2.9	6.9
EBITDA	15,189	12.1	102	5.8	10.5	16.9
Total Liabilities	15,189	72.7	37.3	55.1	68.8	83.9
Total Debt	15,189	53.1	35.9	28.9	46.7	68.1
Short-term Debt/Debt	15,189	14.3	28.6	0	0	10.4

(a) *Notes: This table presents descriptive statistics of the firm-level sample of PE-backed firms, restricting the sample to post-buyout years. Post-buyout includes firm-year observations at or after the year A. All variables are in percentages of book assets (except Total Assets, which is expressed in USD, and Sales/Assets, which is a ratio)*

Table A4: Robustness of Benchmark Results: Estimation with Full Sample

	(1)	(2)	(3)
$PE \times EBITDA$	0.014**	0.014**	0.014***
	(0.006)	(0.006)	(0.009)
$EBITDA$	0.002	0.003	0.002
	(0.002)	(0.002)	(0.002)
R-squared	0.351	0.353	0.357
Firm FE	Y	Y	Y
Year FE	Y	N	N
BankxYear FE	N	Y	Y
Sector×Year	N	N	Y
N	58,720	58,708	58,695

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports robustness of Table 3 when estimated on the full sample. PE takes value 1 for firm-years when a company is under PE-ownership. The matched control group is constructed as outlined in Section 2.2. The dependent variable is Δ $L_{b,i,t}$ the change in committed bank credit from bank b to firm f, scaled by beginning-of-period total assets of firm f. Time-varying controls are the same as the benchmark in Table 3. Sector FE is defined as the 2-digit NAICS-level. Standard errors are clustered at the borrower level.*

Table A5: Covid-Shock with Additional Controls

$Y_{i,t}$: $1(CF\ Debt)$	Assets<$ 1 Bn			Assets< $ 0.5 Bn		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post \times PE$	0.051***	0.047***	0.046***	0.053***	0.048***	0.048***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
PE	-0.022	-0.019	-0.017	-0.047	-0.037	-0.036
	(0.033)	(0.034)	(0.034)	(0.038)	(0.039)	(0.039)
$log(EAD)$	-0.010***	-0.010***	-0.010***	-0.011***	-0.012***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Utilization Rate	0.003	0.004	0.006	0.004	0.005	0.006
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
R-squared	0.709	0.718	0.719	0.721	0.730	0.732
Firm Controls	Y	Y	Y	Y	Y	Y
Loan Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Bank × Year-Qtr FE	Y	Y	Y	Y	Y	Y
Sector × Year-Qtr FE	N	Y	Y	N	Y	Y
Origination Year-Qtr FE	N	N	Y	N	N	Y
N	2.17e+05	2.17e+05	2.17e+05	1.94e+05	1.94e+05	1.94e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports robustness of Table 6 by including two additional controls: loan utilization rate and expected utilization at default. We report estimates of linear probability model at the loan-quarter level, where the dependent variable is an indicator specifying if a loan issued by bank b to firm i in year-quarter t is cash flow-based or not. The sample runs from 2019:Q1 to 2020:Q4. Post takes value 1 in the first four quarters of 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 pre-Covid-19. PE is an indicator for PE-sponsored firms. All regressions include firm controls (profitability, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair) and loan controls (interest rate, interest rate spread, maturity, risk rating and loan purpose indicators). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

Table A6: Aggregate Income Shock and Probability of Earnings-Based Debt: Full Sample

	(1)	(2)	(3)
$Post \times PE$	0.044***	0.041***	0.041***
	(0.007)	(0.007)	(0.007)
PE	-0.052*	-0.019	-0.019
	(0.025)	(0.024)	(0.024)
R-squared	0.649	0.651	0.656
Loan Controls	Y	Y	Y
Firm Controls	Y	Y	Y
Firm FE	Y	Y	Y
Firm FE	Y	Y	Y
BankxYear FE	Y	Y	Y
Sector×Year	N	Y	Y
Originationa Year-Qtr	N	N	Y
N	2.79e+05	2.79e+05	2.79e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports robustness of Table 6 by re-estimating on the full sample, including relatively larger firms. We report estimates of linear probability model at the loan-quarter level, where the dependent variable is an indicator specifying if a loan issued by bank b to firm i in year-quarter t is cash flow-based or not. The sample runs from 2018:Q1 to 2020:Q4. Post takes value 1 in the first four quarters of 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 pre-Covid-19. PE is an indicator for PE-sponsored firms. All regressions include firm controls (profitability, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair), loan controls (interest rate, interest rate spread, maturity) and loan fixed effects (risk rating, loan type and loan purpose). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

Table A7: Aggregate Income Shock and Amount of Earnings-Based Debt Issuance

	Assets $< 1Bn$			Assets $< 0.5Bn$		
	(1)	(2)	(3)	(4)	(5)	(6)
$PE \times Post$	0.009***	0.009***	0.009***	0.010***	0.010***	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
PE	-0.002	-0.001	-0.000	-0.007	-0.006	-0.005
	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)	(0.009)
R-squared	0.808	0.810	0.811	0.813	0.815	0.816
Firm Controls	Y	Y	Y	Y	Y	Y
Loan Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Bank × Year-Qtr FE	Y	Y	Y	Y	Y	Y
Sector × Year-Qtr FE	N	Y	Y	N	Y	Y
Origination Year-Qtr FE	N	N	Y	N	N	Y
N	2.59e+05	2.59e+05	2.59e+05	2.33e+05	2.32e+05	2.32e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports OLS estimates at the loan-quarter level, where the dependent variable is the committed amount of cash flow-based debt for a given loan l, issued by bank b to firm i in year-quarter t. A loan is classified as cash flow-based if it is secured by a blanket lien or is unsecured. The sample runs from 2019:Q1 to 2020:Q4.* $Post_t$ *takes value 1 in the first four quarters of 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 pre-Covid-19.* PE_i *is an indicator equal to one if firm i is PE-sponsored in time t. All regressions include firm controls (profitability, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair) and loan controls (interest rate, interest rate spread, maturity, risk rating and loan purpose indicators). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

Table A8: Robustness of Benchmark Result: Additional Matching on Liquidity

Matching Covariates	PE Sample		Matched Sample			
	Mean	SD	Mean	SD	Mean diff.	Standardized Bias
Log Size	18.65	2.2	18.49	2.7	0.16	6.4
Tangible Assets	73.35	28.2	73.26	26.5	0.09	0.4
Liquidity	8.2	11.9	9.8	12.5	-1.6	-12.8
EBITDA	15.89	101	17.58	75.5	-1.69	-1.8
Leverage	45.1	28.2	44.4	33.6	0.7	1.8

(a) *Notes: This table reports covariate balance tests between PE-backed and matched Non PE-backed firms. Matching is executed using propensity scores (Rosenbaum and Rubin, 1983)* within *each 2-digit NAICS industry in time $t-1$, where t is the year of the buyout. Different from the baseline, we also match on ex-ante liquidity (debt/asset) in addition to size, tangibility, leverage and earnings.*

Table A9: Matched Diff-in-Diff Estimates: Changes in Bank Credit Commitments

$\Delta L_{f,b,t}$	*Assets* $<$ \$ 1 *Bn*		*Assets* $<$ \$ 0.5 *Bn*	
	(1)	(2)	(3)	(4)
$PE \times EBITDA$	0.019***	0.019***	0.020***	0.021***
	(0.007)	(0.007)	(0.007)	(0.007)
$EBITDA$	0.006**	0.006**	0.006**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)
R-squared	0.357	0.364	0.363	0.370
Firm Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
BankxYear FE	Y	Y	Y	Y
Sector×Year	N	Y	N	Y
N	32,904	32,896	27,322	27,313

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports robustness tests of Table 3 with an alternate matching procedure, we we also match on ex-ante liquidity in addition to size, tangibility, leverage and earnings. We report difference-in-differences estimates of debt issuance on an interaction between PE-ownership and firm earnings proxied by EBITDA/beginning of year book assets.* $PE_{i,t}$ *takes value 1 for firm-years when a company is under PE-ownership. The dependent variable is* $\Delta L_{i,b,t}$ *the change in committed bank credit from bank b to firm i, scaled beginning-of-period total assets of firm* f*. In the first two columns, we define small firms as those with book assets less than \$ 1 billion, and in the last two columns as those with book assets less than \$ 0.5 billion. Sector FE is defined as the 2-digit NAICS-level. Standard errors are clustered at the borrower level.*

Table A10: Aggregate Income Shock and Probability of Earnings-Based Debt: Alternate Pre-Covid-19 Sample

	Assets < $1Bn$		Assets < $0.5Bn$	
	(1)	(2)	(3)	(4)
$PE \times Post$	0.035***	0.035***	0.037***	0.037***
	(0.008)	(0.008)	(0.008)	(0.008)
PE	-0.035	-0.036	-0.049*	-0.050*
	(0.025)	(0.025)	(0.029)	(0.029)
R-squared	0.674	0.676	0.683	0.685
Firm Controls	Y	Y	Y	Y
Loan Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
BankxYear-Qtr FE	Y	Y	Y	Y
Sector×Year-Qtr FE	N	Y	Y	N
Origination Year-Qtr FE	N	N	Y	N
N	3.96e+05	3.96e+05	3.56e+05	3.56e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports estimates of linear probability model at the loan-quarter level, where the dependent variable is an indicator specifying if a loan issued by bank b to firm i in year-quarter t is cash flow-based or not. The sample runs from 2018:Q1 to 2020:Q4. Post takes a value 1 in the first four quarters of 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 pre-Covid-19. PE is an indicator for PE-sponsored firms. All regressions include firm controls (profitability, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair), loan controls (interest rate, interest rate spread, maturity) and loan fixed effects (risk rating, loan type and loan purpose). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

Table A11: Change in Earnings following Aggregate Shock: Robustness Test

$Y_{i,t}$: Δ *Earnings*	*Assets* < 1 *Bn*		*Assets* < 0.5 *Bn*	
	(1)	(2)	(3)	(4)
Post × *PE*	0.038*	0.043*	0.041*	0.048*
	(0.020)	(0.024)	(0.023)	(0.027)
PE	0.002	0.002	-0.001	0.000
	(0.017)	(0.017)	(0.020)	(0.020)
R-squared	0.474	0.486	0.476	0.489
Firm FE	Y	Y	Y	Y
Year FE	Y	N	Y	N
Sector×Year	N	Y	N	Y
N	19757	19747	17691	17682

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports robustness tests for results reported in Table 8. The key difference is we no longer match on pre-shock debt structure and only on size, earnings, tangibility and liquidity. As before, the dependent variable is the change in earnings scaled by beginning-of-period total assets. Post takes value of 1 in 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 in pre-Covid-19 years. Firm controls include the natural log of book assets, return on assets and leverage. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

Table A12: Robustness Test: Covid-Shock with Reputation Dummy

$Y_{i,t}: 1(CF\ Debt)$	Assets<$ 1 Bn			Assets< $ 0.5 Bn		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post \times PE$	0.053***	0.049***	0.048***	0.056***	0.051***	0.050***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
PE	-0.027	-0.023	-0.021	-0.061	-0.050	-0.048
	(0.035)	(0.036)	(0.036)	(0.038)	(0.040)	(0.040)
$1 * (Reputation)$	-0.032	-0.043	-0.046	0.034	0.006	0.009
	(0.075)	(0.076)	(0.076)	(0.087)	(0.087)	(0.087)
R-squared	0.688	0.695	0.697	0.697	0.705	0.707
Firm Controls	Y	Y	Y	Y	Y	Y
Loan Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Bank × Year-Qtr FE	Y	Y	Y	Y	Y	Y
Sector × Year-Qtr FE	N	Y	Y	N	Y	Y
Origination Year-Qtr FE	N	N	Y	N	N	Y
N	2.59e+05	2.59e+05	2.59e+05	2.33e+05	2.32e+05	2.32e+05

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports robustness of Table 6 by including an additional control: dummy variable for high-reputation sponsors, defined in Appendix A. We report estimates of linear probability model at the loan-quarter level, where the dependent variable is an indicator specifying if a loan issued by bank b to firm i in year-quarter t is cash flow-based or not. The sample runs from 2019:Q1 to 2020:Q4. Post takes value 1 in the first four quarters of 2020 to capture a quasi-exogenous aggregate earnings shock, and 0 pre-Covid-19. PE is an indicator for PE-sponsored firms. All regressions include firm controls (profitability, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair) and loan controls (interest rate, interest rate spread, maturity, risk rating and loan purpose indicators). Non PE-backed firms are selected such that they issued any cash flow-based debt in the calendar year preceding Covid-19. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the firm level.*

Table A13: Sensitivity of Firm-Level Bank Credit to Earnings: PE Sample

$Y_{i,b,t}$: *Bank Commitment*	*Assets* < \$ 1 *Bn*		*Assets* < \$ 0.5 *Bn*	
	(1)	(2)	(3)	(4)
EBITDA	0.216***	0.213***	0.225***	0.222***
	(0.027)	(0.027)	(0.028)	(0.027)
R-squared	0.754	0.759	0.749	0.752
Firm FE	Y	Y	Y	Y
Firm Controls	N	Y	N	Y
BankxYear FE	Y	Y	Y	Y
N	24726	24706	21880	21861

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *This table presents regression estimates of total bank credit $y_{i,b,t}$ from bank b to PE-backed firm i in year t, scaled beginning-of-period total assets of firm i. Total bank credit includes the sum of credit lines and term loans (from bank b to firm i in year t). Earnings are proxied by EBITDA/beginning-of-period total assets. Firm controls include share of tangible assets, cash and marketable securities, accounts receivables, inventory, loss given default, and the natural log of firm size (i.e., log of book assets). All variables are defined in Appendix A. Standard errors are clustered at the borrower level.*

Table A14: Reputation Effect within PE sample only

	Assets < \$1 *Bn*		*Assets* < \$0.5 *Bn*	
	(1)	(2)	(3)	(4)
Reputation × *Post*	0.043**	0.053***	0.044*	0.074***
	(0.017)	(0.020)	(0.023)	(0.025)
R-squared	0.841	0.867	0.859	0.882
Firm FE	Y	Y	Y	Y
BankxYear FE	Y	Y	Y	Y
SectorxYear	N	Y	N	Y
N	13,990	13,760	12,201	11,974

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports re-estimated coefficients of (4), with the estimation restricted to PE-backed loans only. Reputation takes a value of 1 if a given firm is backed by a high reputation sponsor, 0 otherwise. Post takes a value of 1 in any of the 4 quarters of 2020 to capture the Covid Shock similar to 6. All regressions include firm controls (EBITDA, accounts receivables, tangibility, liquidity, book assets, total quarterly bank debt between a given bank-firm pair), loan controls (interest rate, interest rate spread, maturity) and loan fixed effects (risk rating, loan type and loan purpose). Lower order terms such as $Reputation_i$ is absorbed by firm FE. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the borrower level.*

Table A15: Loan Pricing

$Y: log(1 + Spread)$	$Assets < \$1\ Bn$		$Assets < \$0.5\ Bn$	
	(1)	(2)	(3)	(4)
PE	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$1 * (CF)$	-0.003***	-0.003**	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$PE \times 1 * (CF)$	0.002*	0.003*	0.001	0.000
	(0.001)	(0.002)	(0.001)	(0.002)
R-squared	0.557	0.625	0.668	0.732
Firm FE	Y	Y	Y	Y
BankxYear-Qtr FE	Y	Y	Y	Y
SectorxYear-Qtr	N	Y	N	Y
N	148,473	147,771	121,803	120,990

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table reports re-estimated coefficients the effect of cash flow based debt on loan spreads. The dependant variable is $log(1 + spread)$. CF is an indicator for a cash-flow based loan. Sector FE is defined at the 2-digit NAICS-level. Standard errors are clustered at the borrower level.*

Table A16: Direct Lender Database Descriptive Statistics

Panel A: Assets below $ 1B	N	Mean	SD	p25	p50	p75
Total Assets	10596	222.33	222.07	52.38	141.26	330.60
Ln(Assets)	10596	4.78	1.31	3.96	4.95	5.80
EBITDA/Lagged Assets	7048	0.18	0.32	0.07	0.12	0.20
Cash/Assets	10090	0.06	0.08	0.01	0.03	0.08
Debt/Assets	9891	0.63	0.44	0.41	0.55	0.74
Net PPE/Assets	10261	0.16	0.20	0.02	0.07	0.21
New Debt Issuance/Lagged Assets	6617	0.19	0.55	-0.02	0.02	0.18
Capex/Lagged Assets	5790	0.05	0.12	0.01	0.02	0.05
Asset Growth	7115	0.32	1.03	-0.06	0.01	0.22
Panel B: Assets below $ 500 mn	**N**	**Mean**	**SD**	**p25**	**p50**	**p75**
Total Assets	9257	154.77	132.41	44.82	113.03	239.40
Ln(Assets)	9257	4.53	1.21	3.80	4.73	5.48
EBITDA/Lagged Assets	6087	0.18	0.33	0.07	0.12	0.21
Cash/Assets	8783	0.07	0.09	0.01	0.04	0.08
Debt/Assets	8580	0.64	0.46	0.40	0.55	0.74
Net PPE/Assets	8964	0.16	0.20	0.02	0.07	0.21
New Debt Issuance/Lagged Assets	5675	0.18	0.55	-0.02	0.02	0.17
Capex/Lagged Assets	5004	0.05	0.12	0.01	0.02	0.05
Asset Growth	6178	0.31	1.02	-0.07	0.01	0.21

(a) *Notes: This table reports the summary statistics of key financial variables for PE-backed firms reliant on direct lenders (Jang, 2022). The sample period is between 2009 and 2021. Panel A presents the statistics for firms with book assets less than $ 1 billion. Panel B presents the same statistics for firms with book assets less than $ 500 million.*

Table A17: Sensitivity of Debt Issuance and Investments to Earnings (Direct Lender Database)

	Assets < \$ 1 *Bn*			*Assets* < \$ 0.5 *Bn*		
$Y_{i,b,t}$:	Debt Issuance	CapEx	Asset Growth	Debt Issuance	CapEx	Asset Growth
EBITDA	0.257**	0.039**	0.679**	0.264**	0.037*	0.617***
	(0.110)	(0.017)	(0.230)	(0.118)	(0.020)	(0.197)
R-squared	0.64	0.70	0.63	0.65	0.70	0.65
Firm FE	Y	Y	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
N	3214	2610	1004	2655	2174	2669
N Firms	1000	847	3230	842	719	844

* $p < .10$, ** $p < .05$, *** $p < .01$

(a) *Notes: This table plots regression estimates of net debt issuance and capital expenditures, scaled beginning-of-period total assets, and and year-over-year growth in total assets for direct lender-reliant PE-backed firms (Jang, 2022). Earnings is proxied by EBITDA/beginning-of-period total assets. Firm controls include lagged EBITDA, book debt, cash and marketable securities, and net PP&E, scaled by beginning-of-period total assets, and the natural log of total assets, following Lian and Ma (2021). Firm- and year- fixed effects are included. Standard errors are clustered at the borrower and year level.*

A4 Details on the Theoretical Framework

We now provide the detailed solution to our theoretical framework in Section 4.5, thereby also proving Proposition 1. We solve the model backward starting from $t = 2$. In $t = 1$, the firm chooses its actions, if any, to maximize its continuation equity value. In $t = 0$, the firm chooses its actions to maximize its initial equity value.

At time $t = 2$, the firm's equity value reads

$$V_2 := E(1-\tau) - D(1+r_2) + r_2\tau D,$$

which are the earning after taxes $E(1-\tau)$ minus debt repayment $D(1+r_2)$ plus tax shield $r_2\tau D$. We focus in what follows on debt levels satisfying the constraint $D(1+r_2) \leq E$, so $V_2 \geq 0$.

A4.1 Time $t = 1$

Absent a cash flow shortfall, there is no action to take. Thus, the only interesting case to consider is when the firm has experienced a cash flow shortfall of L dollars. If the firm liquidates and accordingly defaults on its debt, its equity value becomes $[A - D(1+r)]^+ = \max\{A - D(1+r), 0\}$. If the firm raises equity of $\Delta = L$ dollars and does not liquidate nor default on debt, its continuation value (net the cost of raising equity δ) equals

$$\hat{V}_1 := \frac{V_2}{1+r} - L - \delta.$$

Accordingly, the firm raises $\Delta = L$ dollars of equity upon cash flow shortfall and there is no liquidation (i.e., $q = 0$) if and only if

$$\hat{V}_1 \geq [A - D(1+r)]^+. \tag{16}$$

Notably, we can rewrite (16) as

$$D \leq \Big(E(1-\tau) - (1+r)(L + \delta + [A - D(1+r)]^+)\Big)\left(\frac{1}{1+r_2(1-\tau)}\right) \tag{17}$$

Thus, we obtain that $q = 1$ if (16) does not hold and $q = 0$ when (16) holds, which is equivalent to (12).

As a next step, we define the maximum debt level conditional on no equity issuance and liquidation/default upon cash flow shortfall (i.e., $q = 1$):

$$D^{Def} := \frac{A}{1+r}, \tag{18}$$

which is determined according to a binding constraint (9) (i.e., for $D = D^{Def}$, the constraint (9) binds). Next, define the maximum level of debt conditional on the firm raising new equity and not liquidating upon the cash flow shortfall (i.e., $q = 0$):

$$D^{Equity}(\delta) := \Big(E(1-\tau) - (1+r)(L+\delta)\Big)\left(\frac{1}{1+r_2(1-\tau)}\right), \tag{19}$$

which is obtained from a binding constraint (16). By construction and by the incentive constraint (16), it also follows that the firm raises equity to avert liquidation and $q = 0$ if and only if $D \leq D^{Equity}(\delta)$. Overall, we must have

$$D \leq \max\left\{D^{Def}, D^{Equity}(\delta)\right\}$$

for debt to be risk-free (i.e., free from default risk).

Next, we define $\hat{\delta}$ such that $D^{Equity}(\hat{\delta}) = D^{Def}$. Combining (18) and (19) and rearranging,we can solve

$$\hat{\delta} = \frac{E(1-\tau)}{1+r} - L - A(1+r_2(1-\tau))(1+r)^2 \tag{20}$$

in closed form. It readily follows that $D^{Equity}(\delta) > D^{Def}$ if and only if $\delta < \hat{\delta}$. Because the firm raises equity to avert liquidation, so that $q = 0$, if and only if $D \leq D^{Equity}(\delta)$, it also follows that $q = 0$ for $\delta < \hat{\delta}$. To see this suppose to the contrary that $\delta < \hat{\delta}$ and $q = 1$. Then, $D \leq D^{Def}$ and, by definition of $\hat{\delta}$, we get $D < D^{Equity}(\delta)$. However, when $D < D^{Equity}(\delta)$, the firm has strict incentives to raise equity $\Delta = L$ at $t = 1$ upon cash flow shortfall to avert liquidation, which implies $q = 0$ and leads to a contradiction.

A4.2 Time $t = 0$

We consider the firm's optimal choice of debt at time $t = 0$, taking into account the continuation game at time $t = 1$.

First, consider the firm's equity value at time $t = 0$ *conditional* on liquidation and default (i.e., $q = 1$). Conditional on $q = 1$, equity value at time $t = 0$ equals

$$V_0^{Def}(D) = D + \frac{1-p}{(1+r)^2}\Big(E(1-\tau) - D(1+r)^2 + r_2 D\tau\Big) + \frac{p[A - D(1+r)]^+}{1+r},$$

where the constraint (9) must hold in that $D \leq D^{Def}$. Taking the derivative with respect to D, we obtain

$$\frac{\partial V_0^{Def}(D)}{\partial D} = p - p\mathbf{1}_{\{A > D(1+r)\}} + \frac{r_2\tau}{(1+r)^2} > 0. \tag{21}$$

Thus, the firm maxes out its debt capacity and optimally chooses $D = D^{Def}$. Thus, in optimum equity value conditional on $q = 1$ equals $V_0^{Def}(D^{Def})$.

Second, consider the firm's equity value *conditional* on equity issuance and no liquidation/default (i.e., $q = 0$). Conditional on $q = 0$ and new equity issuance upon cash flow shortfall, equity value at $t = 0$ equals

$$V_0^{Equity}(D) = D + \frac{1}{(1+r)^2}\Big(E(1-\tau) - D(1+r)^2 + r_2 D\tau\Big) - \frac{p(L+\delta)}{1+r}, \tag{22}$$

where D satisfies the incentive compatibility constraint (16) (that is, raising equity to ensure $q = 0$ is ex-post incentive compatible). Taking the derivative with respect to D, we obtain

$$\frac{\partial V_0^{Equity}(D)}{\partial D} = \frac{r_2 \tau}{(1+r)^2} > 0.$$

Thus, the firm maxes out its debt capacity and optimally chooses $D = D^{Equity}(\delta)$. Overall, we have for the optimal level of debt D^*:

$$D^* = \begin{cases} D^{Def} & \text{if} \quad q = 1, \\ D^{Equity}(\delta) & \text{if} \quad q = 0. \end{cases} \tag{23}$$

We then define $\tilde{\delta}$ as the value of δ such that

$$V_0^{Def}(D^{Def}) = V_0^{Equity}(D^{Equity}(\tilde{\delta})).$$

As $V_0^{Def}(D^{Def})$ is independent of δ and $V_0^{Equity}(D^{Equity}(\tilde{\delta}))$ strictly decreases with δ, it readily follows that $V_0^{Equity}(D^{Equity}(\tilde{\delta})) > V_0^{Def}(D^{Def})$ for $\delta < \tilde{\delta}$ as well as $V_0^{Equity}(D^{Equity}(\tilde{\delta})) < V_0^{Def}(D^{Def})$ for $\delta > \tilde{\delta}$. Combining (18), (19), (21), and (22), it is possible (after some algebra) to solve for

$$\tilde{\delta} = \frac{E(1+r)(1-\tau) - A\tau}{(1+r)^2} - A(1-\tau) - L \tag{24}$$

in closed-form.

We complete the characterization of the choice of debt and the implied levels of equity injection at $t = 1$ as well as the liquidation probability q. Recall that when $\delta \leq \hat{\delta}$, we have $q = 0$ (as $q = 1$ is not incentive compatible). Thus, it is optimal for the firm to choose $D = D^* = D^{Equity}(\delta)$ (see also (23)). Proceeding, we now distinguish two different parameters.

First, suppose that $\tilde{\delta} \leq \hat{\delta}$. Then, for $\delta \geq \hat{\delta}$, we have $V_0^{Equity}(D^{Equity}(\tilde{\delta})) \leq V_0^{Def}(D^{Def})$. Thus, optimal $D^* = D^{Def}$ and $q = 1$. In this case, the threshold $\overline{\delta}$ from Proposition 1 satisfies $\overline{\delta} = \hat{\delta}$.

Second, suppose that $\tilde{\delta} > \hat{\delta}$. Then, for $\delta \in [\hat{\delta}, \tilde{\delta})$, we have $V_0^{Equity}(D^{Equity}(\tilde{\delta})) > V_0^{Def}(D^{Def})$. Then, optimal $D^* = D^{Equity}(\delta)$ and $q = 1$. In this case, the threshold $\overline{\delta}$ from Proposition 1 satisfies $\overline{\delta} = \tilde{\delta}$.

Overall, we can write

$$\overline{\delta} = \max\{\tilde{\delta}, \hat{\delta}\} \tag{25}$$

Lastly, note from the closed-form expressions (20) and (24) that both $\tilde{\delta}$ and $\hat{\delta}$ strictly decrease with L, implying that $\overline{\delta}$ strictly decreases with L too and $\frac{\partial \overline{\delta}}{\partial L} < 0$ in case of differentiability.

A4.3 Precautionary Cash Holdings

We now consider that the firm can accumulate precautionary cash holdings and derive a sufficient condition for which this is not the case. Under this sufficient condition (see (26) below), the model solution presented before and in the main text remains valid and the firm (optimally) does not accumulate any precautionary cash (as in the main text).

Suppose that cash holdings earn a rate of return γ which is below the risk-free (discount rate), i.e., $\gamma < r$, which is a common assumption in the corporate finance literature (e.g., Bolton et al. (2011)). Then, liquidation upon cash flow shortfall can be averted in two ways, (i) by holding $L/(1+\gamma)$ dollars as precautionary reserve at time $t = 0$ (which is worth $\frac{L}{1+\gamma}(1+\gamma) = L$ dollars at $t = 1$) or (ii) by raising equity upon cash flow shortfall. To avert liquidation and achieve $q = 0$, raising equity ex-post ($t = 1$) is cheaper than hoarding cash ex-ante (at $t = 0$) if

$$L - \frac{p}{1+r}(L+\delta) \geq L - \frac{L}{1+\gamma} + \frac{(1-p)L}{1+r}$$

which is equivalent to

$$p\delta \leq \frac{r-\gamma}{1+\gamma}. \tag{26}$$

Thus, condition (26) is a sufficient condition for the firm not accumulating any cash as precautionary savings. Intuitively, the firm finds it optimal not to hold precautionary, when the cost of raising equity (δ), the probability of cash flow shortfall (p) is small, or the return on cash relative to the risk-free rate ($\gamma - r$) is small.